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PIPES AND FITTINGS

744

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SCRANTON, PA.

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PIPES AND FITTINGS

PIPES

WROUGHT-IRON PIPE

INTRODUCTION

1. In the erection of steam-heating apparatus, pipes and various fittings having a shape suitable for the requirements are used. The fittings are made of cast iron, brass, malleable iron, and steel castings, tapped or otherwise finished to connect the pipes together. The pipes used in most of the work are of wrought iron or steel.

2. For connecting pipes to the fittings, screw threads are generally used. These threads have a standard number of threads to the inch for different sizes of wrought-iron and steel pipe, and the fittings are tapped with threads to suit the thread of the pipe. The threads are made with a slight taper, the thread in cutting starting with a small groove, increasing in depth until a full thread is cut. They are usually made right hand; that is, the pipe in screwing into the fitting is turned to the right. Left-hand threads are also used on pipe and in fittings; in buying pipe, the left-hand thread must be specially ordered, as the regular pipe on the market is threaded only right hand.

TABLE I

DIMENSIONS OF STANDARD WROUGHT-IRON PIPE

Diameter: Nominal Internal. Inches	Diameter: Actual External. Inches	Diameter: Approximate Internal Diameter. Inches	Thickness. Inches	Circumference: External. Inches	Circumference: Internal. Inches	Transverse Areas: External. Square Inches	Transverse Areas: Internal. Square Inches	Transverse Areas: Metal. Square Inches	Length of Pipe Per Square Foot of External Surface. Feet	Length of Pipe Per Square Foot of Internal Surface. Feet	Length of Pipe Containing Cubic Foot. Feet	Nominal Weight Per Foot. Pounds	Number of Threads Per Inch of Screw.
1/8	.405	.270	.068	1.272	.848	.129	.0573	.0717	9.440	14.150	2513.000	.241	27
1/4	.540	.364	.088	1.696	1.144	.229	.1041	.1249	7.075	10.490	1383.300	.420	18
3/8	.675	.494	.091	2.121	1.552	.358	.1917	.1663	5.657	7.730	751.200	.559	18
1/2	.840	.623	.109	2.639	1.957	.554	.3048	.2492	4.547	6.130	472.400	.837	14
3/4	1.050	.824	.113	3.299	2.589	.866	.5333	.3327	3.637	4.635	270.000	1.115	14
1	1.315	1.048	.134	4.131	3.292	1.358	.8626	.4954	2.904	3.645	166.900	1.668	11½
1¼	1.660	1.380	.140	5.215	4.335	2.164	1.4960	.6680	2.301	2.768	96.250	2.244	11½
1½	1.900	1.611	.145	5.969	5.061	2.835	2.0380	.7970	2.010	2.371	70.660	2.678	11½
2	2.375	2.067	.154	7.461	6.494	4.430	3.3560	1.0740	1.608	1.848	42.910	3.609	11½
2½	2.875	2.468	.204	9.032	7.753	6.492	4.7840	1.7080	1.328	1.547	30.100	5.739	8
3	3.500	3.067	.217	10.996	9.636	9.621	7.3880	2.2430	1.091	1.245	19.500	7.536	8
3½	4.000	3.548	.226	12.566	11.146	12.566	9.8870	2.6790	.955	1.077	14.570	9.001	8
4	4.500	4.026	.237	14.137	12.648	15.904	12.7300	3.1740	.849	.949	11.310	10.665	8
4½	5.000	4.508	.246	15.708	14.162	19.635	15.9610	3.6740	.764	.848	9.020	12.490	8
5	5.563	5.045	.259	17.477	15.849	24.306	19.9900	4.3160	.687	.757	7.200	14.502	8
6	6.625	6.065	.280	20.813	19.054	34.472	28.8880	5.5840	.577	.630	4.980	18.762	8
7	7.625	7.023	.301	23.955	22.063	45.664	38.7380	6.9260	.501	.544	3.720	23.271	8
8	8.625	7.982	.322	27.096	25.076	58.426	50.0400	8.3860	.443	.478	2.880	28.177	8
9	9.625	8.937	.344	30.238	28.076	72.760	62.7300	10.0300	.397	.427	2.290	33.701	8
10	10.750	10.019	.366	33.772	31.477	90.763	78.8390	11.9240	.355	.382	1.820	40.065	8
11	11.750	11.000	.375	36.914	34.558	108.434	95.0330	13.4010	.325	.347	1.510	45.028	8
12	12.750	12.000	.375	40.055	37.700	127.677	113.0980	14.5790	.299	.319	1.270	48.985	8
13	14.000	13.250	.375	43.982	41.626	153.938	137.8870	16.0510	.273	.288	1.040	53.921	8
14	15.000	14.250	.375	47.124	44.768	176.715	159.4850	17.2300	.255	.268	.903	57.893	8
15	16.000	15.430	.285	50.260	48.480	201.060	187.0400	14.0200	.239	.248	.770	62.000	8

STANDARD WROUGHT-IRON PIPE

3. Standard wrought-iron pipe is made in the sizes and weights shown in Table I. A large amount of steel pipe is made, and sometimes sold as wrought-iron pipe. Its general appearance is the same as that of wrought-iron pipe, but on close examination the grain of the metal will show a finer fiber than wrought iron. Steel pipe can also be distinguished by threading it with the dies, as the closer grain and tendency to unevenness in its composition cause the threads to chip and break, while the wrought-iron pipe has a malleability that allows perfect threading. The pipe is sold in lengths averaging about 18 to 20 feet. The small sizes are shipped in bundles convenient for handling. All pipe from $\frac{1}{8}$ inch to $1\frac{1}{4}$ inches nominal diameter is butt-welded, and all pipes $1\frac{1}{2}$ inches in diameter and larger are lap-welded. The standard weight pipe is tested by hydraulic pressure to 300 pounds per square inch for the butt-welded sizes, and to 500 pounds pressure for the lap-welded sizes. The safe-working pressure for standard pipe is about 100 pounds per square inch; this allows a fair margin of safety to provide for deterioration of the structure of the metal, by expansion and contraction, and for corrosion.

EXTRA-STRONG WROUGHT-IRON PIPE

4. Extra-strong wrought-iron pipe has the same external dimensions as the standard pipe; the wall of the pipe is made heavier, which reduces the size of the bore. This should be taken into account where pipe of a stated size is required. Extra-strong pipe is always shipped without threads or couplings, unless otherwise ordered. This pipe is used for high steam pressures and for heavy pressures in hydraulic work. Its sizes and weights are given in Table II.

DOUBLE EXTRA-STRONG WROUGHT-IRON PIPE

5. Double extra-strong wrought-iron pipe has a thicker wall than extra-heavy tubing. Its external diameter, however, is the same as that of standard wrought-iron

TABLE II

STANDARD DIMENSIONS OF EXTRA-STRONG WROUGHT-IRON PIPE

Diameter			Thickness.	Circumference		Transverse Areas			Length of Pipe Per Square Foot of		Nominal Weight Per Foot.
Nominal Internal. Inches	Actual External Inches	Approximate Internal Inches	Inches	External. Inches	Internal. Inches	External. Square Inches	Internal. Square Inches	Metal. Square Inches	External Surface. Feet	Internal Surface. Feet	Pounds
1/8	405	.205	.100	1.272	.644	.129	.033	.086	9.433	18.632	.29
1/4	.540	.294	.123	1.696	.924	.229	.068	.161	7.075	12.986	.54
3/8	.675	.421	.127	2.121	1.323	.358	.139	.219	5.657	9.070	.74
1/2	.840	.542	.149	2.639	1.703	.554	.231	.323	4.547	7.046	1.09
3/4	1.050	.736	.157	3.299	2.312	.866	.452	.414	3.637	5.109	1.39
1	1.315	.951	.182	4.131	2.988	1.358	.710	.648	2.904	4.016	2.17
1 1/4	1.660	1.272	.194	5.215	3.996	2.164	1.271	.893	2.301	3.003	3.00
1 1/2	1.900	1.494	.203	5.969	4.694	2.835	1.753	1.082	2.010	2.556	3.63
2	2.375	1.933	.221	7.461	6.073	4.430	2.935	1.495	1.608	1.975	5.02
2 1/2	2.875	2.315	.280	9.032	7.273	6.492	4.209	2.283	1.328	1.649	7.67
3	3.500	2.892	.304	10.996	9.085	9.621	6.569	3.052	1.091	1.328	10.25
3 1/2	4.000	3.358	.321	12.566	10.549	12.566	8.856	3.710	.955	1.137	12.47
4	4.500	3.818	.341	14.137	11.995	15.904	11.449	4.455	.849	1.000	14.97
5	5.563	4.813	.375	17.477	15.120	24.306	18.193	6.120	.687	.793	20.54
6	6.625	5.750	.437	20.813	18.064	34.472	25.967	8.505	.577	.664	28.58

TABLE III

STANDARD DIMENSIONS OF DOUBLE EXTRA-STRONG WROUGHT-IRON PIPE

Diameter				Circumference		Transverse Areas			Length of Pipe Per Square Foot of		
Nominal Internal. Inches	Actual External. Inches	Approximate Internal. Inches	Thickness. Inches	External. Inches	Internal. Inches	External. Square Inches	Internal. Square Inches	Metal. Square Inches	External Surface. Feet	Internal Surface. Feet	Nominal Weight Per Foot. Pounds
$\frac{1}{2}$	.840	.244	.298	2.639	.766	.554	.047	.507	4.547	15.667	1.70
$\frac{3}{4}$	1.050	.422	.314	3.299	1.326	.866	.139	.727	3.637	9.049	2.44
1	1.315	.587	.364	4.131	1.844	1.358	.271	1.087	2.904	6.508	3.65
$1\frac{1}{4}$	1.660	.885	.388	5.215	2.780	2.164	.615	1.549	2.304	4.317	5.20
$1\frac{1}{2}$	1.900	1.088	.406	5.969	3.418	2.835	.930	1.905	2.010	3.511	6.40
2	2.375	1.491	.442	7.461	4.684	4.430	1.744	2.686	1.608	2.561	9.02
$2\frac{1}{2}$	2.875	1.755	.560	9.032	5.513	6.492	2.419	4.073	1.328	2.176	13.68
3	3.500	2.284	.608	10.996	7.175	9.621	4.097	5.524	1.091	1.672	18.56
$3\frac{1}{2}$	4.000	2.716	.642	12.566	8.533	12.566	5.794	6.772	.955	1.406	22.75
4	4.500	3.136	.682	14.137	9.852	15.904	7.724	8.180	.849	1.217	27.48
5	5.563	4.063	.750	17.477	12.764	24.306	12.965	11.340	.687	.940	38.12
6	6.625	4.875	.875	20.813	15.315	34.472	18.666	15.806	.577	.784	53.11

pipe. Double extra-strong pipe is always shipped without threads and couplings unless otherwise ordered. Its sizes and weights are given in Table III.

BOILER TUBES

6. Boiler tubes, sometimes called **outside-diameter pipes,** are usually made of charcoal iron; they are lap-welded and have a high tensile strength coupled with a ductility that enables the ends of the tubes to be expanded into the boiler plates, such as the crown sheets and tube sheets, and beaded over. Steel boiler tubes are made to the same dimensions; formerly the wrought-iron tubes gave better results, as the average steel tube was liable to contain carbon patches that soon rusted and thus caused the tubes to pit, especially if vegetable oils were used for the lubrication of engines whose water of condensation is used for feeding the boiler. To-day, however, due to improved processes of manufacture, solid-drawn seamless steel boiler tubes are decidedly superior to wrought-iron boiler tubes, possessing just as much ductility and having greater tensile strength. The sizes of boiler tubes are given in Table IV. For locomotive work, boiler tubes are made one gauge heavier than given in the table.

7. Lap-welded **semisteel tubes** are manufactured expressly for locomotive work, and hence need not be considered here.

GALVANIZED-IRON PIPE

8. The **galvanized-iron pipe** used in steam heating in the smaller sizes is the regular standard wrought-iron pipe coated inside and outside with a covering of zinc in an electric bath. It has the same dimensions as standard black pipe. Galvanized pipe is sometimes used in steam-fitting work for exhaust and vapor pipes, drip pipes, etc. exposed to the outer atmosphere. It is also used in underground

TABLE IV

STANDARD LAP-WELDED CHARCOAL-IRON BOILER TUBES

Diameter		Thickness.	Circumference		Transverse Areas			Length of Tube Per Square Foot of		Nominal Weight Per Foot.
External. Inches	Internal. Inches	Inches	External. Inches	Internal. Inches	External. Square Inches	Internal. Square Inches	Metal. Square Inches	External Surface. Feet	Internal Surface. Feet	Pounds
1	.856	.095	3.142	2.689	.785	.575	.210	3.819	4.462	.90
1¼	1.106	.095	3.927	3.475	1.227	.961	.266	3.056	3.453	1.15
1½	1.334	.095	4.712	4.191	1.767	1.398	.369	2.547	2.863	1.40
1¾	1.560	.095	5.498	4.901	2.405	1.911	.494	2.183	2.448	1.66
2	1.810	.095	6.283	5.686	3.142	2.573	.569	1.909	2.110	1.91
2¼	2.060	.095	7.069	6.472	3.976	3.333	.643	1.698	1.854	2.16
2½	2.282	.109	7.854	7.169	4.909	4.090	.819	1.528	1.674	2.75
2¾	2.532	.109	8 639	7.954	5.940	5.035	.905	1.389	1.509	3.04
3	2.782	.109	9.425	8.740	7.069	6.079	.990	1.273	1.373	3.33
3¼	3.010	.120	10.210	9.456	8.296	7.116	1.180	1.175	1.260	3.96
3½	3.260	.120	10.996	10.241	9.621	8.347	1.274	1.091	1.172	4.28
3¾	3.510	.120	11.781	11.027	11.045	9.676	1.369	1.018	1.088	4.60
4	3.732	.134	12.566	11.724	12 566	10.939	1.627	.955	1.024	5.47

work where the ground is moist, the coating of zinc preventing rapid rusting. The larger sizes, where but little pressure is carried, are made of a lighter and cheaper material, such as galvanized sheet iron built in the form of pipe.

SPIRAL RIVETED PIPE

9. The **spiral riveted pipe** is made of sheets of black wrought iron, of certain wire-gauge thickness, split up into ribbons or narrow strips, and passed over a system of rollers that roll it into the required shape, which is shown in Fig. 1.

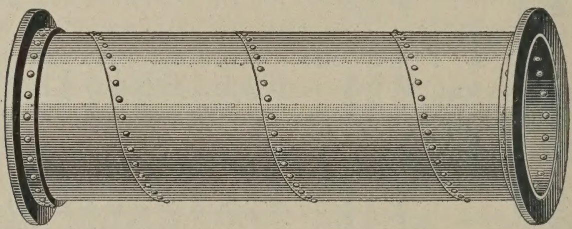


FIG. 1

The edges lapping over each other are riveted together by a riveting machine over a mandrel. The lengths must be made to measure, and are fitted at the ends with cast-iron flanges, drilled to suit other flanges, or a templet. The sections can thus be bolted together. The pipe is placed in an electric bath, and a coating of zinc deposited over it, which makes the riveted joint absolutely tight. The sizes are given in Table V.

The safe-working pressure of this pipe is considered to be one-third of the bursting pressure. These pipes are tested to a pressure of 150 pounds per square inch. They are furnished in lengths to order up to 20 feet.

The thicknesses represented by the Birmingham wire-gauge numbers appearing in Table V are as follows: No. 20, .035 inch; No. 18, .049 inch; No. 16, .065 inch; No. 14, .083 inch; No. 12, .109 inch.

TABLE V

SPIRAL-RIVETED FLANGED PRESSURE PIPE, DOUBLE GALVANIZED

Size. Inches	Diameter of Flanges. Inches	Thickness, B. W. G.	Weight Including Flanges Per Foot. Pounds	Bursting Pressure Per Square Inch. Pounds
3	6	No. 20	$2\frac{1}{4}$	900
4	7	No. 20	3	700
5	8	No. 20	4	550
6	9	No. 18	5	700
7	10	No. 18	6	600
8	11	No. 18	7	500
9	13	No. 18	8	450
10	14	No. 16	11	500
11	15	No. 16	12	450
12	16	No. 16	14	400
13	17	No. 16	15	380
14	18	No. 14	20	470
15	19	No. 14	22	450
16	$21\frac{1}{4}$	No. 14	24	400
18	$23\frac{1}{4}$	No. 14	29	370
20	$25\frac{1}{8}$	No. 14	34	325
22	$28\frac{1}{4}$	No. 12	40	365
24	30	No. 12	50	335

FLANGED WROUGHT-IRON PIPE

10. Flanged wrought-iron pipe can be made with forged flanges welded on, as shown by the end view and section in Fig. 2. The lengths are made to suit conditions. As screw joints cut into the pipe and thus reduce the strength, the pipe with forged flanges will stand a greater pressure and hence can be lighter in weight for the same pressure than ordinary pipe. By the use of these welded flanges, a large amount of the hand labor in erecting can be saved. Table VI, known as the Master Steam-Fitters' Standard, is adopted for these flanges. The letters *A*, *B*, *C*, *D*, and *E* heading the first five columns relate to the dimensions shown by the same letters in Fig. 2.

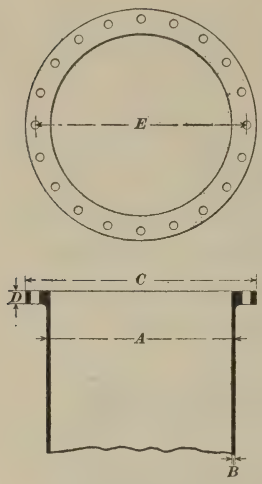


FIG. 2

11. Pipe up to 16 inches can be fitted with flanges screwed on, but above 16 inches the flanges are usually fastened to the pipe by rivets passing through a boss of the flange, as in Fig. 1. Sometimes the flange is fastened by expanding and peening the pipe into a recess formed in the flange.

CAST-IRON PIPE

12. In some manufacturing plants it is advisable to use cast iron instead of wrought iron for main steam pipes and branches, especially where acids are used, or where the pipes

FIG. 3

must be placed unprotected in the ground. It is also good practice to use cast iron for return mains where water is used that contains sulphur or any other substance tending to rapidly corrode wrought iron. A length of cast-iron pipe

TABLE VI

MASTER STEAM-FITTERS' STANDARD FOR WELDED FLANGES

A	*B*	*C*	*D*	*E*	Number of Bolts	Size of Bolts	Weight of Pair of Flanges Finished. Pounds
6 5/8	1/4	11	1 1/8	9 1/2	8	5/8	45
7 5/8	5/16	12 1/2	1 3/16	10 3/4	8	5/8	56
8	5/16	13	1 3/16	11 1/4	8	5/8	58
8 5/8	5/16	13 1/2	1 3/16	11 3/4	8	3/4	60
9 5/8	5/16	15	1 3/16	13 1/4	12	3/4	73
10	3/8	15 1/2	1 1/4	13 1/2	12	3/4	78
10 3/4	3/8	16	1 1/4	14 1/4	12	3/4	85
12	3/8	18	1 1/4	15 1/2	12	7/8	98
12 3/4	3/8	19	1 1/4	17	12	7/8	108
14	3/8	21	1 3/8	18 3/4	12	7/8	148
15	3/8	22 1/4	1 3/8	20	16	7/8	162
16	3/8	23 1/2	1 7/16	21 1/4	16	7/8	195
18	3/8	25	1 9/16	22 3/4	16	1	207
20	3/8	27 1/2	1 11/16	25	20	1	275
22	3/8	29 1/2	1 7/8	27 1/4	20	1	320
24	7/16	32	2	29 1/2	20	1 1/8	400
26	7/16	34 1/4	2	31 3/4	24	1 1/8	440
28	7/16	36 1/2	2 1/8	34	28	1 1/8	510
30	7/16	38 3/4	2 1/8	36	28	1 1/8	560

is shown in Fig. 3. The usual method of connecting cast-iron pipes is by flange joints having a fibrous packing between the flanges. Flange joints should be fitted in such a manner that the only stress the pipe is subjected to will be the tensile stress due to the steam pressure. The standard sizes are given in Table VII.

TABLE VII

SIZES AND WEIGHTS OF CAST-IRON FLANGED PIPE

Bore in Inches	Thickness of Metal in Inches								
	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$
	Weight Per Foot in Pounds								
2	5.52	8.74	12.27	16.11	20.25	24.70	29.45	34.52	39.88
$2\frac{1}{2}$	6.75	10.58	14.73	19.18	23.95	28.99	34.36	40.04	46.02
3	7.93	12.43	17.18	22.24	27.61	22.29	39.27	45.56	52.16
$3\frac{1}{2}$	9.20	14.27	19.64	25.31	31.29	37.58	44.18	51.08	58.29
4	10.43	16.11	22.09	28.38	34.98	41.88	49.09	56.60	64.43
$4\frac{1}{2}$	11.66	17.95	24.54	31.45	38.66	46.18	54.00	62.13	70.56
5	12.89	19.79	27.00	34.52	42.34	50.47	58.91	67.65	76.70
$5\frac{1}{2}$	14.11	21.63	29.45	37.58	46.02	54.76	63.81	73.17	82.84
6	15.34	23.47	31.91	40.65	49.70	59.06	68.72	78.69	88.97
7	17.79	27.15	36.82	46.79	57.06	67.65	78.54	89.74	101.24
8	20.25	30.83	41.72	52.92	64.43	76.24	88.36	100.78	113.52
9	22.70	34.52	46.63	59.06	71.79	84.83	98.18	111.83	125.79
10	25.16	38.20	51.54	65.19	79.15	93.42	107.99	122.87	138.06
11	27.61	41.88	56.45	71.33	86.52	102.01	117.81	133.92	150.33
12	30.07	46.56	61.36	77.47	93.88	110.60	127.63	144.96	162.60
13	32.52	49.24	66.27	83.60	101.24	119.19	137.45	156.01	174.87
14	34.98	52.92	71.18	89.74	108.61	127.78	147.26	167.05	187.15
15		56.60	76.09	95.87	115.97	136.37	157.08	178.10	199.42

BRASS AND COPPER PIPE

BRASS PIPE

13. For steam-heating work, **brass pipe** is made in all standard iron-pipe sizes up to 6 inches in diameter. It has a thickness nearly equal to that of standard wrought-iron pipe, and hence is of sufficient thickness to be threaded the same. The regular standard lengths are 12 feet; they come without threads. Brass pipe is used chiefly for boiler connections where a pipe with more flexibility than iron is required, and for boiler feedpipes and blow-off pipes, as brass is not so liable as iron to deteriorate under the high temperature in the flue space and smoke chambers of a boiler. Brass pipe is also used for steam coils in water tanks, or water coils in steam tanks for heating feedwater for boilers, etc. Small sizes of brass pipe are used for oil connections in machinery, as they can be easily and neatly bent, and when polished make a neat appearance. The standard sizes are given in the following table:

TABLE VIII

SIZES AND WEIGHTS OF IRON-PIPE SIZE OF BRASS AND COPPER STEAM TUBES

Size of Tube	Inside Diameter. Inches	Outside Diameter. Inches	Length. Feet	Approximate Weight Per Foot	
				Brass	Copper
1/8-inch.......	.27	13/32	12	.30	.31
1/4-inch.......	.36	9/16	12	.43	.45
3/8-inch.......	.49	11/16	12	.58	.61
1/2-inch.......	.62	13/16	12	.80	.84
3/4-inch.......	.82	1 1/16	12	1.17	1.23
1 -inch.......	1.04	1 5/16	12	1.67	1.75
1 1/4-inch.......	1.38	1 5/8	12	2.42	2.54
1 1/2-inch.......	1.61	1 7/8	12	2.92	3.07
2 -inch.......	2.06	2 3/8	12	4.17	4.38
2 1/2-inch.......	2.46	2 7/8	12	5.00	5.25
3 -inch.......	3.06	3 1/2	12	8.00	8.40
3 1/2-inch.......	3.50	4	12	10.00	10.50
4 -inch.......	4.02	4 1/2	12	12.00	12.00
5 -inch.......	5.04	5.56	8 to 10	15.93	17.30
6 -inch.......	6.06	6.66	6 to 8	20.69	22.38

COPPER PIPE

14. Copper pipe can be had in the same dimensions as the brass pipe referred to in Table VIII, but is generally made only to order. The smaller sizes of copper pipe are used for the same purpose as brass pipe; that is, for feed-water heaters, drip pipes, boiler connections, etc.

Seamless copper pipe of the iron-pipe sizes can be used for spring bends for main steam lines; sizes less than 4 inch can be bent cold. In steamship work, copper tubing for connecting the boilers and engines is generally made from sheet copper, with the seams dovetailed and then brazed. The ends of such tubes are provided with flanges brazed and riveted on; the sections are then bolted together in position. As the beating of the copper sheet draws the copper lighter in some parts than others, tubes thus made are not so well adapted for very high pressures as the seamless tubes.

FLEXIBLE METALLIC TUBING

15. A peculiar form of tubing consists of a strip of metal, formed by a special machine over a mandrel, with a curved edge on one side that laps into the curved edge of the opposite side of the same strip, the spiral seam acting as a wedge to press the two interlocking edges tightly on each other. By the ingenious method in which the pipe is made, it becomes flexible and yet remains steam-tight.

16. Fig. 4 shows a flexible metallic tube *a* in section. It is connected to a coupling *b*, which may be screwed to an iron pipe. To connect the tube and coupling, the coupling ring *c* is slipped over the end of the tubing *a*, and then the gland *d* is screwed over the tubing. Next, some asbestos-thread packing is wrapped around the tubing

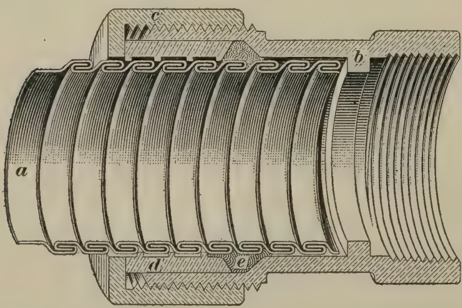


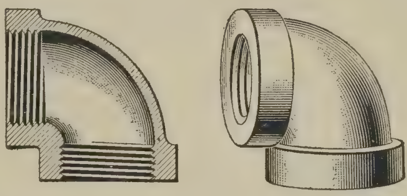
FIG. 4

at *e*; the end of the tubing is then pushed into *b*, as shown, and the ring *c* is screwed over *b* until the packing at *e* is tightly compressed. Care must be taken, however, not to twist the tubing, as then it may leak. A little clear space must be allowed at the end of the tubing, as shown.

PIPE FITTINGS

ELBOWS

17. Elbows are fittings that are used to change the direction of a pipe. They are made with right-hand threads and also with left-hand threads; also, with one thread right hand and the other thread left hand. The term **ell** is a trade abbreviation for elbow. The **right-angle elbow,** also called **quarter elbow,** is used for making right-angle, or 90°, turns in continuous lengths of piping. Fig. 5 shows, in section at (*a*) and in perspective at (*b*), a common cast-iron quarter elbow. It will be observed that the tapped openings are reenforced with an extra amount of metal around the threads. This extra metal is required to prevent the fitting from being split when a pipe is being screwed into it. All cast-iron fittings are provided with a reenforcement.



(*a*) (*b*)

FIG. 5

18. Elbows with left-hand threads, commonly called **left-hand elbows,** are used in places where fittings cannot be turned, as occurs in connecting up the last fitting of a loop.

19. Fig. 6 shows a **right-and-left-quarter elbow,** where, as a distinguishing mark, the left-hand end has ribs cast on it, as shown at *a*. Some manufacturers, however, indicate the left-hand thread by the letter *L* marked on the fitting.

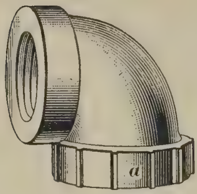


FIG 6

20. Reducing elbows, one of which is shown in Fig. 7, are used for the same purpose as **straight elbows,** which are tapped the same size at both outlets; they differ from straight elbows in that the outlet end is tapped (threaded) for a smaller pipe. There are no right-and-left threaded reducing elbows manufactured; if required, they must be made to order. In fact, all reducing fittings are made with right-hand threads.

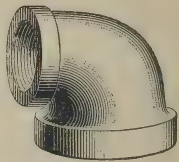


FIG. 7

21. Eighth, or **45°, elbows** are intended to change the direction in which the pipe runs 45°. Eighth elbows are at present only made with right-hand threads, and are not made in reducing sizes. They should be used in preference to 90° elbows when possible. A 45° elbow is shown in Fig. 8.

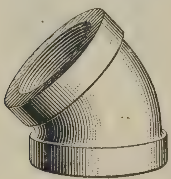


FIG. 8

22. A **side-outlet elbow,** or **three-way elbow,** which has three outlets, is shown in Fig. 9. It is seldom used, because it makes it difficult to properly allow for expansion and contraction of the pipes; but there are some cases where it is necessary. For instance, they may be used for a drip pipe to drain the water of condensation from long runs of pipe at a bend; such a drip pipe or relief should be fitted so that expansion and contraction are provided for as fully as possible. Side-outlet elbows, while listed in most catalogues, are seldom kept in stock.

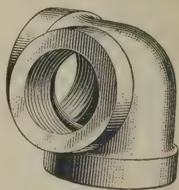


FIG. 9

23. Street elbows are used in steam-fitting work only in places where the connection must be made too close to use the regular form of elbow and a short piece of pipe. The name is derived from the use to which they are put by plumbers and gas-fitters, being used by them to connect water and gas pipes to openings tapped in the street mains. They are sometimes used by boiler makers in making a close right-angle connection to the shell of a boiler or a tank, and by steam fitters in connecting feed-pipes where space is limited between the boiler and brick-work, etc. They are also called male and female elbows, the female part *b*, Fig. 10, having a thread into which a pipe can be fitted and the male part being the outer threaded end shown at *a*. Street elbows are usually made of malleable iron; nearly all malleable-iron fittings are reenforced by a round bead, shown at *b*.

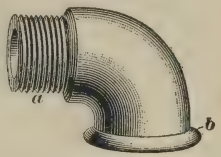


FIG. 10

TEES

PURPOSE AND DESIGNATION

24. In **tees,** as the name implies, the three connecting outlets form a T. These fittings are made in various forms and are used to take a branch pipe from a line of pipe at right angles without changing the direction of the continuous pipe. Any number of branches may be taken from a main line by screwing tees on the line. Tees are all made with right-hand threads and can be had in many different forms. The method of designating the size of a tee is to first state the size of the run and then the size of the branch. By **run** is meant a line of piping entering and leaving a fitting in the same straight line. Thus, in Fig. 11,

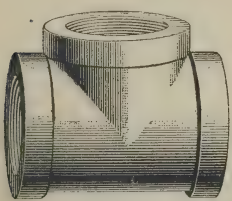


FIG. 11

if all the openings were 1-inch, it would properly be called a 1″ × 1″ tee. It is known more commonly to the trade, however, as a *straight 1-inch tee.* If the openings are different in size, it is necessary to be very careful in naming a tee. Thus, Fig. 12 shows a run of 1½-inch pipe reduced to a run

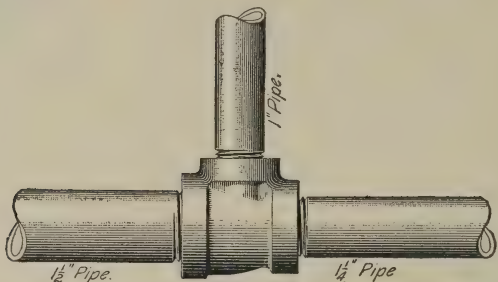


FIG. 12

of 1¼-inch pipe by a tee that has a 1-inch branch. This is known as a 1½″ × 1¼″ × 1″ tee. The largest size tapping on the run is always noted first; then the other tapping on the run; then the branch tapping. This simple rule, which is universally adopted, should be remembered in ordering, to prevent confusion.

25. When a tee is made so that the branch taken from the main line is smaller than the run, as shown in Fig. 13,

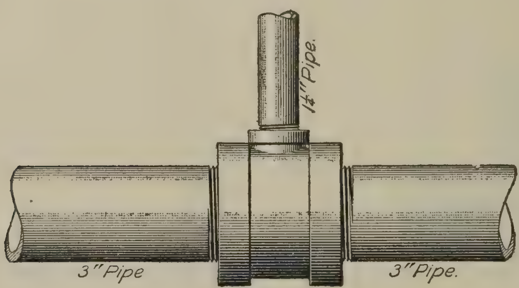


FIG. 13

the fitting is really a *reducing tee*, but it is not listed as such in manufacturers' catalogues. It is simply listed as a

tee with a reduced outlet. The tee shown in Fig. 13 is designated as a 3″ × 3″ × 1¼″ *tee*. In other words, it has a 3-inch run and a 1¼-inch outlet.

REDUCING, BULLHEAD, SIDE-OUTLET, AND ANGLE TEES

26. Reducing tees are tees that have the run reduced in size, as shown in Fig. 12. A reducing tee may also have a reducing side outlet. In designating reducing tees, the largest opening does not take precedence. The side outlet is always named last, even though it is larger than either of the others.

27. A **bullhead tee** is shown in Fig. 14. It will be observed that the run of the pipe is smaller than the outlet. It is used generally where the larger pipe must have branches both ways at an angle of 90° to it. It can be made reducing on the run, the same as is shown in Fig. 12.

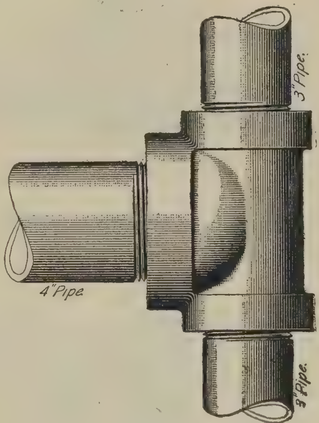


FIG. 14

28. A **side-outlet tee,** which is shown in Fig. 15, is a fitting that is listed in manufacturers' catalogues, but is very seldom used, as it is difficult to provide for free expansion and contraction of the pipes when it is employed. This fitting is usually made to order, and can be made to suit the conditions. Fittings of this kind are designated by first stating the sizes of the run and then the sizes of the side outlets. If it is desired to have a reducing tee made with side outlets, the fitting should be shown by a sketch made, as in Fig. 16, to indicate the positions of

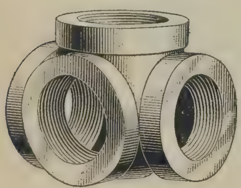


FIG. 15

the side outlets. The fitting shown in Fig. 16 (*a*) is designated as a 4″ × 2½″ × 2″ × 1½″ *side-outlet tee, opening looking to right.* The one shown in Fig. 16 (*b*) is called a 4″ × 2½″ × 2″ × 1½″ *side outlet tee, opening looking to the left.* The dotted circle in Fig. 16 (*b*) shows that the side outlet is on the left of the fitting, and the manufacturers would make it accordingly. From the foregoing, it will be seen that the terms right and left are applied to the side outlet in accordance with the side they are on when looking at the fitting in the direction of the run, and from the larger opening toward the smaller one.

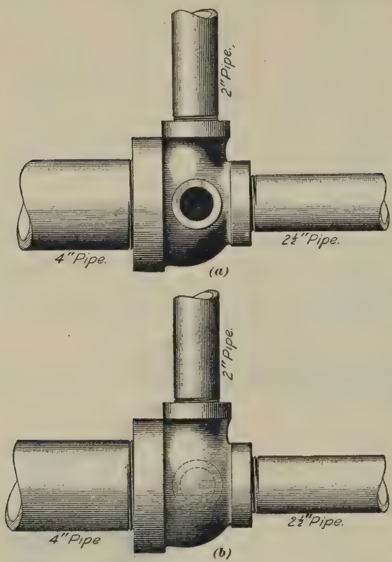


FIG. 16

29. An **angle tee, or Y branch,** is a fitting having an outlet that branches off at an angle of 45° to the axis of the main run. It is designated, or read, the same as a tee, except that the kind of outlet is designated by calling it a **Y**. Thus, the fitting shown in Fig. 17 is called a 4″ × 3″ × 3″ *reducing* **Y** *branch.* These fittings are kept in stock in straight sizes, that is, with all outlets the same size; the reducing fittings must be made to order to suit the conditions.

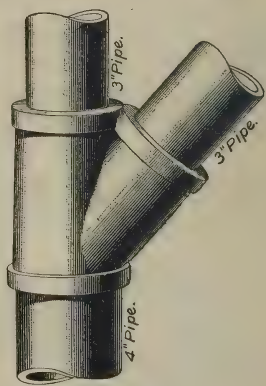


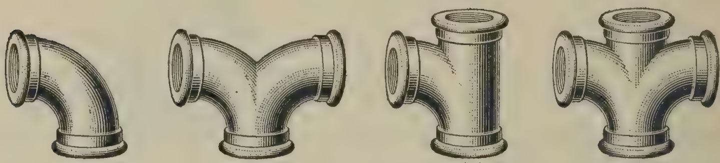
FIG. 17

radiator above it. The arrows show the direction of the currents. This fitting is used principally on vertical runs of pipe.

32. Fig. 21 shows a distributing fitting similar to Fig 20. It has a large body at the branch; the back of the fitting is straight on the run and the deflector *a* is short. This fitting is used in horizontal runs of pipe to favor the branch.

LONG-TURN FITTINGS AND CROSSES

33. **Long-turn fittings** are made similar to the standard steam fittings, but have a long bend, which allows an easy flow of the liquid. In Fig. 22 is shown a long-turn elbow in (*a*), a double-branch elbow in (*b*), a tee in (*c*), and



(a) (b) (c) (d)

FIG. 22

a cross in (*d*). The fitting in (*b*) is sometimes called a **twin elbow.** The standard makes of these fittings are all regular straight sizes; the reducing sizes are special. The double-branch elbow is similar to the bullhead tee and is very useful for branching from a main; it makes a superior connection.

34. **Crosses** are fittings used where two branches opposite each other are taken from a main run at an angle of 90° with it, as shown in Fig. 23. Although they are used extensively, their use is objectionable, as the flow from the main in two directions taken from the same point causes the current to flow unevenly, unless the branches are very well equalized. In many cases, the branch currents cut off the flow in the

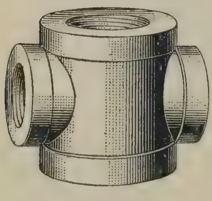


FIG. 23

run by the sharp turn made by them. There is not so much trouble in using crosses for water, as the velocity is seldom as high as the velocity with which steam flows through pipes.

NIPPLES

35. Nipples are short pieces of pipe, threaded on both ends, that are used in connecting the fittings when short connections are to be made. They are made in all sizes of pipe, kept in stock in various lengths, and are classified as *close*, *shoulder*, *short*, and *long nipples.* Nipples are made with right-hand screw threads, left-hand screw threads, and right-and-left screw threads. The left-hand nipples are very seldom used, and are generally cut to suit peculiar conditions, such as occur in coupling up two left-hand fittings, when it is not possible to get others, or where it will occasion much loss of time to get the proper fittings.

36. Fig. 24 shows a right-hand **close nipple** having a right-hand taper thread cut on each end. The nipple is short enough to allow the fittings to come close together, whence the name.

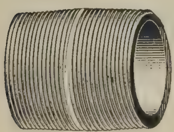


FIG. 24

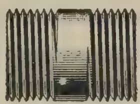


FIG. 25

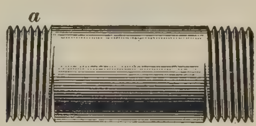


FIG. 26

37. Fig. 25 shows a right-hand **shoulder nipple.** The threads are both right hand. The short piece of unthreaded pipe in the center is called a **shoulder.**

38. Fig. 26 shows a **right-and-left short nipple.** The end *a* is threaded left hand.

39. Long nipples differ from short nipples only in length. Some people call them **short pieces of pipe.** There are no specific lengths that define a long nipple.

40. The right-hand nipple is used where it is possible to extend connections by the turning of the fitting. The right-and-left nipple is used where space will not permit the turning on of a fitting, as in connecting up to a radiator or main. As the pipe wrench is used on such a nipple, it should be made of extra-heavy pipe, to prevent its being flattened or split by the wrench. Nipples up to 2 inches can be cut with the ordinary hand tools, but the work is very slow and, hence, expensive; nipples cut by machinery can be purchased much cheaper than they can be made by hand.

41. A nipple with a hexagon center is shown in Fig. 27. It is made of malleable iron cast in the form of a sleeve. As it is used chiefly for connecting materials that cannot be turned, it is threaded right hand and left hand, as shown. It is screwed up by means of a narrow wrench, usually called a **spanner,** and applied to the hexagon center. In these nipples, both threads have the same length. They are used chiefly for connecting up sections of radiators.

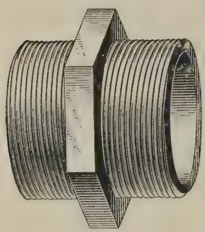


FIG. 27

42. **Locknut nipples,** or **long screws,** are used in some cases for final connections, especially in gas work. In steam-heating work, however, they are used only in places where

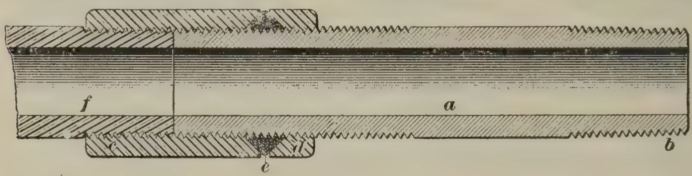


FIG. 28

the connecting pipes will not permit springing in order to make the connection. They consist of a short pipe *a*, Fig. 28, with a taper thread *b* on one end sufficiently long to make a tight screw joint in the fitting; the other end is threaded with a straight thread somewhat longer than the coupling *c*. A short locknut *d*, also called a **follower,** made by cutting a coupling in two pieces in the lathe and turning a cup-like recess in it, is fitted to the thread. This will serve as a gland and will hold packing *e* when the follower is screwed up tight against the coupling. After the nipple *a* is screwed into the fitting and lined up for final connection, the coupling *c* is screwed up tight on the other pipe *f*. A lamp-wick or hemp gasket soaked in white lead is wound around at *e* and the follower is screwed up tight.

43. Although the long screw is shown and described here, it is not recommended for steam-heating work. Right-and-left fittings should be used instead. The long screw may be used with impunity only where the temperature of the pipes connected by it does not change much and where there is no vibration or jarring of the pipe.

44. Locknuts are used, as previously described, to make up joints on long screws, etc. They are also used on the ends of pipes to serve as supports, or to protect threads in shipping. A locknut is shown in Fig. 29. The face *a* screws against the gasket and is faced and slightly countersunk.

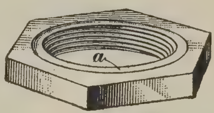


FIG. 29

COUPLINGS

45. Couplings are simply sleeves threaded inside. They are used for connecting up continuous lengths of pipe. Each length of standard pipe shipped by manufacturers is fitted with a coupling on one end, except extra-strong pipes. A common wrought-iron or steel pipe coupling is shown in Fig. 30. It is tapped right hand at both ends with taper threads.

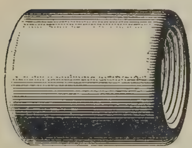


FIG. 30

46. A **reducing coupling** is shown in Fig. 31. This is usually made of cast iron in the larger sizes and of malleable iron in the smaller sizes. The coupling shown is made of cast iron. It consists of a short sleeve with a large opening and a small opening, each tapped to suit the different sizes of pipes to be connected together. An **eccentric,** or **offset reducing coupling,** is shown in Fig. 32. It is used to facilitate the draining of a horizontal pipe and to preserve the bottom alinement. These fittings are only made with right-hand threads.

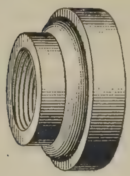


FIG. 31

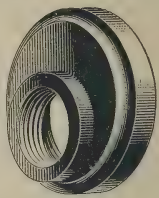


FIG. 32

47. A **right-and-left coupling** is shown in Fig. 33. It is used for coupling up pipe lengths where final joints are to be made and where the pipes cannot be turned. It consists of a sleeve tapped with a right-hand thread in one end and a left-hand thread in the other end. Different makers have different kinds of outside finish for these fittings to distinguish them from common couplings; the illustration represents a good construction. The bars *a*, *a* are the *right* and *left* distinguishing marks, and the beads *b*, *b* are strengthening bands, very much required on such a fitting.

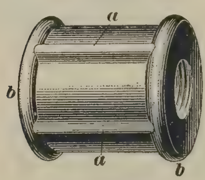


FIG. 33

48. A **solid flange** is shown in Fig. 34. This is sometimes called a **blind plate,** or **blind flange.** It is made of cast iron and is used principally for closing the ends of flanged pipes, etc. Holes are drilled to correspond with the holes in the pipe flange, and the solid flange is secured with bolts and a gasket. Plain flat flanges are generally used up to 18 inches in diameter. For larger sizes, ribbed solid flanges are used. The ribs are cast on to strengthen the flat plate.

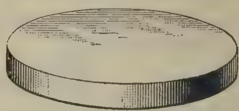


FIG. 34

49. Fig. 35 shows a **common flange** threaded inside to receive the pipe. The bolt holes are not shown in the figure; these are usually drilled to correspond with the bolt holes of the apparatus to which the flange is intended to be bolted. Solid and common flanges can be procured in stock sizes without bolt holes.

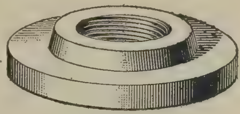


FIG. 35

BUSHINGS, PLUGS, AND CAPS

50. **Bushings** are fittings used to reduce an outlet in a fitting or to connect a pipe to a larger outlet. They are usually made with right-hand threads. Some of them are made with a hexagon top, as shown in Fig. 36, for convenience in screwing the bushing with a monkeywrench. Others are made without the head, as shown in Fig. 37, and are called **faced bushings,** or **flush bushings.** They can be screwed into the opening to form a neat flush finish. Some steam fitters call these bushings **thimbles.**

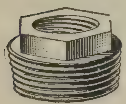


FIG. 36

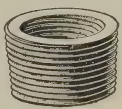


FIG. 37

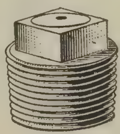


FIG. 38

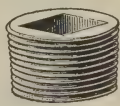


FIG. 39

51. **Plugs** are fittings used to close tapped openings in fittings when the openings are not required. Fig. 38 shows the common form of plug; it is provided with a projecting square head for screwing up with a wrench, and is made of cast iron. Fig. 39 shows a faced plug. It is made so that there will be no projection, and has a square depression in the face of the plug for screwing it in with a square bar or key. These plugs are usually made right hand, but left-hand plugs can be had to order.

52. A **cap** is shown in Fig. 40. It is used to close the end of a pipe, and consists of a hollow casting threaded inside. Some caps are made with a square projection on the back; others are plain, and others are hexagonal on the body. The cap shown has short ribs to allow the pipe wrench to get a good hold in screwing on the cap.

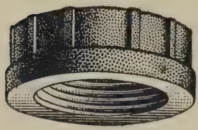


FIG. 40

UNIONS

CONSTRUCTION OF UNIONS

53. Unions are used for final connections in piping, and consist of three parts, namely, two sleeves threaded to screw on the ends of the pipes to be joined, and a threaded coupling ring to draw them together. Unions for steam or hot-water fitting work should have ground joints. Ordinary faced unions with washers between the faces of the parts often leak and cause trouble. It is considered the best practice to dispense with unions on small sizes of pipe, and use right and left threaded connections where possible. In very close connections, however, unions with a ground brass seat may be used, provided the pipes to be joined are not sprung to make the connection.

54. A **universal coupling,** or **union,** has a ground ball joint where the parts come together. It allows pipes to be connected at an angle.

55. Flange unions consist of cast plates having a threaded hole for the pipe, and are faced on one side; they are clamped tightly together by bolts, the bolt holes being either cored or drilled. Some flange unions have pockets on the outside of one flange, as shown at *a*, Fig. 41, in order to prevent the bolt from turning while the nut is being screwed home. A projection, or boss, *b* gives sufficient length to the thread that is tapped into the opening. Flange joints are usually made steam-tight by placing a gasket of some fibrous packing between the flanges. These fittings are used in making final connections for pipe larger than 2 inches in diameter, although in some cases they are used for smaller sized pipe.

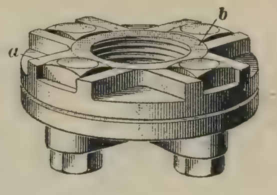


FIG. 41

56. **Shrink flanges** are a special kind of flange that are shrunk on the ends of pipes and riveted on instead of being screwed. They are used for large pipe connections. The end of the pipe is turned to a smooth surface a distance slightly greater than the thickness of the flange. The flange is then bored out, making the opening slightly smaller than the turned end of the pipe. The flange is now expanded by

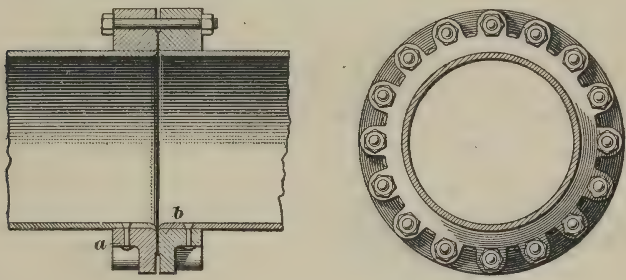


FIG. 42

being heated, and is driven over the end of the pipe; it is then allowed to cool and thus contract, or shrink, into position. Rivet holes are then drilled, and the flange is riveted to the pipe, as shown at *a*, Fig. 42. To insure a steam-tight connection, the end of the pipe is peened over a chamfer in the flange, as at *b*. The flanges are then bolted together with a gasket of packing between them.

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[illegible] cards

DIVISION TEES

30. A **division tee** is a special form of fitting used to divide the current flowing through it, so that each current will have a chance to flow without interference, or to insure that the main current will not flow past a branch without part of it being diverted into the branch. A **plain partition tee** is shown in Fig. 18; it has a straight partition *a* in the

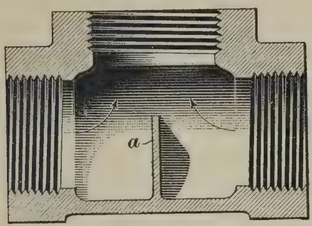


FIG. 18

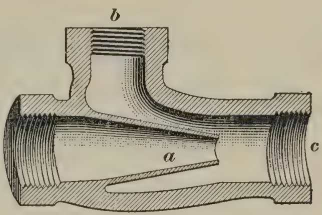


FIG. 19

middle of the fitting. This tee is used when two pipes in the same line connect to a pipe at an angle of 90°, the flow of liquid traveling toward the same branch pipe, as shown by the arrows. Fig. 19 shows a **suction tee.** This has a conical nozzle *a* extending beyond the direct line of the branch *b*, and is used to induce the branch current to flow into the run *c*.

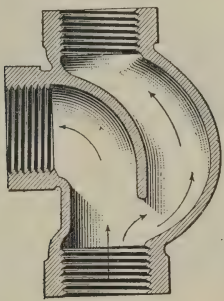


FIG. 20

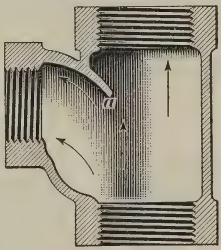


FIG. 21

31. Fig. 20 shows the **O S fitting.** It is used to allow the branch to be favored more than the run, as in riser pipes in steam heating, when a better flow is required at the branch to a radiator on one floor than is required to supply the multiple are first named, as *a ten-branch $1\frac{1}{4}$-inch tee by 2-inch run*, which means that there will be ten pipes $1\frac{1}{4}$ inches in diameter branching out from the manifold, and the body of the manifold, or tee, will have 2-inch tapped openings on the end. If only one outlet is required on the end, it should be ordered as follows: *One end tapped 2 inches, the other end blanked.* Manifolds for coils can be made to order to suit the work. Sometimes it is convenient to have the outlet tapped in the side, but in all cases where back or side outlets are required, they must be ordered special. The tapping is usually right hand, but other tappings can be ordered.

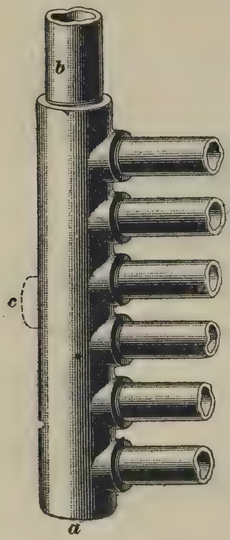


FIG. 46

SPECIAL FITTINGS

63. A cast-iron **offset** is shown in Fig. 47. It can be had in all sizes with an offset of 4 inches, 6 inches, or 8 inches. They are very handy fittings. The chief trouble in using offsets, however, is that they cannot be swung around when near walls, and consequently must often be connected up with right-and-left connections. This is the reason that many fitters prefer using nipples and 45° elbows instead, which are very unsightly, however.

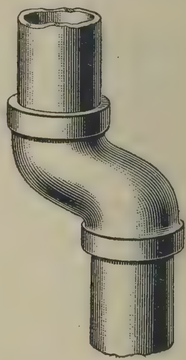


FIG. 47

64. Offset fittings can also be had in the form of tees, crosses, couplings, etc. Fig. 48 shows an **eccentric tee.** The object of this fitting is to prevent lodging places for water in the main *a*, which is always the case where the ordinary reducing fitting placed horizontally is used.

Fig. 49 shows an **eccentric cross.** It is used chiefly for taking a supply both ways from either the top or bottom of

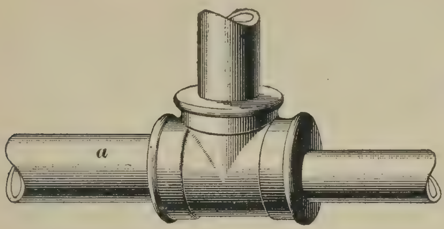


FIG. 48

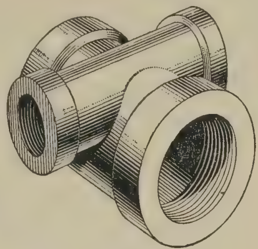
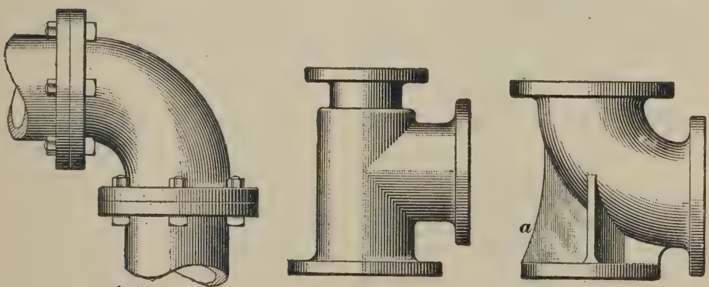


FIG. 49

a main. Eccentric or offset fittings are usually made to order. Sketches showing the branches must be sent with the order.

65. Flanged cast-iron fittings have faced flanges in which the bolt holes are generally drilled to suit a standard templet to insure interchangeability. The benefit derived from using flanged fittings and pipe is that changes in, and additions to, piping can easily be made. Flanged connections are objected to by some people on account of the joints requiring packing and being liable to leak, but if proper provision is made for expansion, so that the piping is not subjected to excessive bending and twisting stresses, and if proper packing is used, the chances of leakage are small.



(a) (b) (c)

FIG. 50

66. Fig. 50 (*a*) shows a cast-iron **flanged elbow** connected to two pipes; a **reducing flanged tee** is shown in

Fig. 50 (*b*); Fig. 50 (*c*) shows a so-called **base elbow,** which has a bracket *a* with a wide base cast on it. This kind of elbow is used at the bottom of a long run of vertical pipe, the base being placed on a masonry pier, or similar suitable foundation, in order to support the weight of the pipe above it. Nearly all kinds of fittings can be bought with flanges instead of tapped ends.

67. Semisteel fittings are made special, and are usually made from special patterns, which conform somewhat to the cast-iron flange fittings and to the long-sweep threaded fittings. They are cast of a special metal having a high tensile strength.

68. The malleable-iron fittings commonly used by plumbers and gas-fitters are not adapted for use with iron pipe for steam work; they will not stand the strains due to expansion and contraction. For this purpose extra-heavy patterns are made, which are used chiefly in connecting up feedpipes and blow-off pipes in the fire-spaces of boilers.

69. There are two kinds of **brass fittings,** those made similar in pattern to malleable-iron fittings and those made similar in pattern to common cast-iron fittings. The latter are preferable for steam work. They are used extensively for feed and blow-off connections, also steam-gauge and water-gauge connections, and in places where iron pipe and fittings would rust out quickly. They are threaded for, and used with, "iron-pipe size brass pipe." These fittings can be polished or otherwise finished as desired.

70. Railing fittings are made chiefly of malleable iron and are used for fences, enclosures around machinery, etc. They are made with right-hand threads, but can be made to order with any thread desired. These fittings can also be made with reducing outlets in various reductions of one or two sizes. They can also be had cast from brass, and either in the rough (that is, as they come from the mold) or finished (that is, polished). The distinguishing feature of these fittings is that the body is spherical in form and the outlets have no beads for reenforcement.

71. Ornamental fittings are made for ornamental finish, chiefly on coils. They are made expressly for this purpose and can be obtained made of cast iron or of cast brass. In ordering these fittings, they should be described fully and the tapping specified, such as *left-hand threads* and *right-hand threads.* With the exception of the ornamentation, they are practically the same as other common fittings.

PIPE SUPPORTS

PLATES, STANDS, BRACKETS, AND SADDLES

72. Hook plates are used to support heating pipes where they are assembled in the form of coils, or other pipes that run parallel to one another. In Fig. 51 (*a*), a **single hook plate** of the common pattern is shown; a **multiple hook plate** of the same pattern is shown in Fig. 51 (*b*); a **single offset hook plate** is shown in Fig. 51 (*c*), and a **multiple offset hook plate** is shown in Fig. 51 (*d*). The ends are offset so that the pipes will be held clear of any small projections on the face of the wall. Hook plates are fastened to the walls with screws or expansion bolts. Care should be taken in ordering hook plates to state the size and number of hooks, which latter are

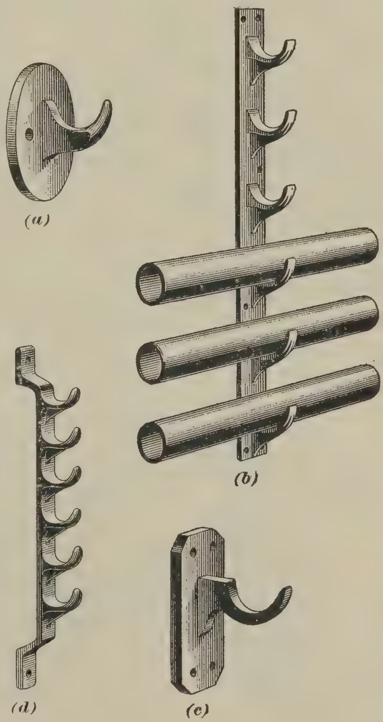


FIG. 51

generally called **branches**; thus, *one ten-branch $1\frac{1}{4}$-inch hook plate*, or *one single $1\frac{1}{4}$-inch hook plate.* If offset plates are to be used, state *one ten-branch $1\frac{1}{4}$-inch hook plate, offset ends, $1\frac{1}{2}$ inches* (or as much as required). Offset hook plates are usually made to order. Hook plates similar to those shown in Fig. 51 can be had pressed out of sheet steel.

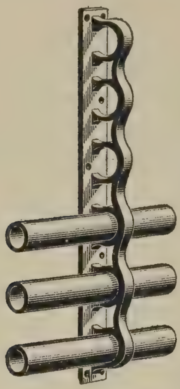


FIG. 52

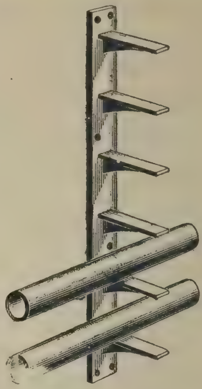
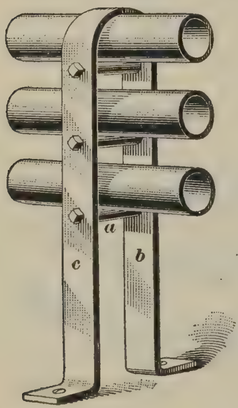
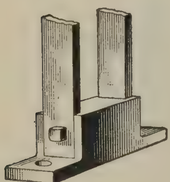


FIG. 53

73. Ring plates have a ring for the pipe, as shown in Fig. 52, instead of the hook shown in Fig. 51. They are used in places where pipes would fall out if hooks were used, as at ceilings and on ships.



(a)



(b)

FIG. 54

74. Expansion plates are similar to hook plates, but instead of hooks the brackets have a flat surface, as shown in Fig. 53. They are used at the corners of long coils to allow the pipes to freely expand and contract. The brackets are made longer than the branches of hook plates.

75. There are numerous places where cast-iron hook plates cannot be used; for example, where pipe coils stand away from a wall. In such cases it is necessary to support the coils from the floor with **coil stands.** In some cases, they are made, as shown in Fig. 54 (*a*), of flat iron with the ends bent to form feet. In other cases, a cast-iron block is made and the iron bent around the coil and bolted to the block, as shown in Fig. 54 (*b*). Each stand should be provided with a support for each pair of pipes or each separate pipe, so as to preserve the alinement. Each support should preferably have a piece of pipe, as *a*, slipped over the bolts to form a distance piece that will prevent the sides *b*, *c* from being bolted tightly against the pipes. This will allow the pipes to expand freely.

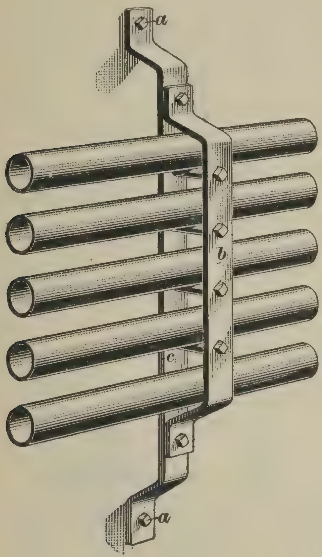


FIG. 55

76. Side-wall, or **ceiling, brackets** are used in many cases to make a strong and serviceable support for pipes and coils. They are forged of iron to the required shape. They are particularly suitable for supporting coils in skylights, on ceilings, or on sloping walls, where the cast-iron hook plate will not give a secure support. Fig. 55 shows such a bracket secured to a brick wall by expansion bolts at *a*, *a*. A forged iron strap or bar *b*, offset at both ends, is bolted to the bar *c*, the bolts forming the pipe supports.

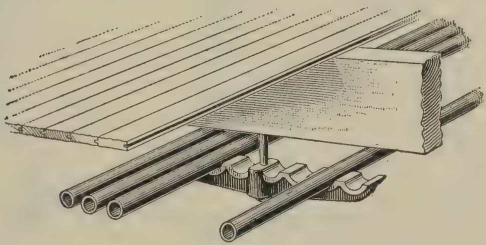


FIG. 56

77. Pipe saddles are made of cast iron; they have notches for the pipes, as shown in Fig. 56. The smaller sizes are made with one hole at the center to admit a bolt for hanging the pipes from the ceiling, as shown in the illustration. Long saddles should have two bolts, one at each end, which make a better support. In naming these fittings, they should be designated, for example, thus, *one ten-pipe $1\frac{1}{4}$-inch saddle*, which is a saddle for ten $1\frac{1}{4}$-inch pipes.

78. Roller supports consist of rollers of cast iron having a hole for a rod to slip through. The rollers are made to suit the size of pipe coil to be used and are usually sold separately. Fig. 57 shows a roller support for four pipes attached to the ceiling. The rod that passes through the rollers is a piece of round steel. It is threaded on the ends and secured in place with locknuts. The hanger shown is secured to the ceiling beams with lagscrews, and is considered to be about the best coil support made.

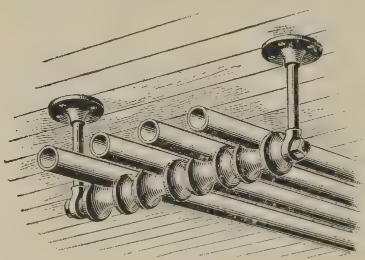


FIG. 57

PIPE HANGERS

79. There are numerous ways of hanging steam pipes, of which some are crude makeshifts that should not be found on good work. No engineer who prides himself on his work will use them. A pipe hanger should be easily adjusted after the line of pipe has been put up and alined, and should be so constructed that sections of pipe can be readily taken down.

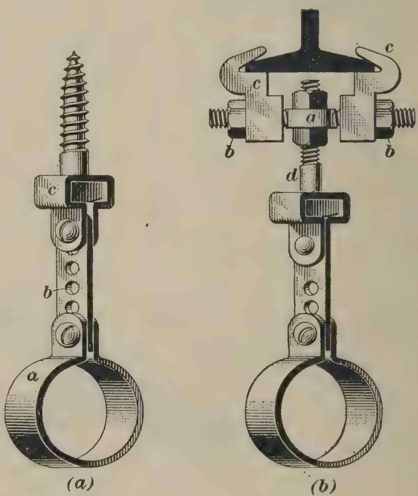


FIG. 58

80. Fig. 58 (*a*) shows the **Ideal pipe hanger.** This is a strong, although light-looking, hanger made of flat steel. The clamp *a* is sprung over the pipe and clamped to the perforated bar *b*, which in turn is clamped to a steel socket *c* enclosing a bolt or lagscrew. It can be adjusted by the flat perforated bar *b*, which is cut off to suit. A beam clamp, as shown in Fig. 58 (*b*), is used for clamping the hanger to iron and steel beams. It is made entirely of steel; the adjusting bar *a* is fitted with locknuts *b*, *b* on each end for holding the toes or hooks *c*, *c* around the beam and at the same time obtain an easy sidewise adjustment. A fine vertical adjustment is obtained by means of the bolt *d*.

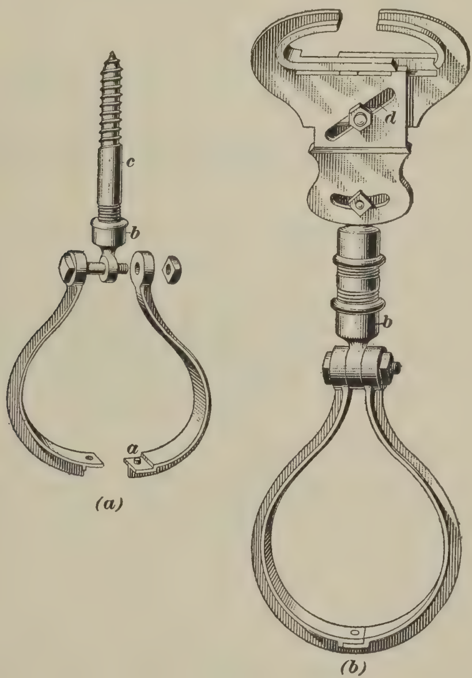


Fig. 59

81. The **Blake hanger,** shown in Fig. 59 (*a*), is made of malleable iron. Its construction somewhat resembles that of the Ideal, with the exception that the clamp is in two parts joined at the bottom with a tongue or pin, as shown at *a*. The clamp is bolted to a socket *b* that is tapped with a pipe thread and into which a lagscrew *c* is screwed. The lagscrew is used for connection to wooden beams. The Blake hanger for iron and steel beams, however, is provided with a nipple that attaches the socket *b* to an adjustable beam clamp. The beam clamp is made with a diagonal slotted hole *d* for a bolt, and allowing adjustment to the iron beam.

82. The **Universal hanger** is a cast-iron hanger, with a ring made in halves and bolted at the bottom; it has an oblong button end at the top, which connects into a box-like casting. This casting is bolted to the same style of socket and lagscrew as used in the Blake hanger. A malleable-iron beam clamp and an additional socket and nipple are used for connection to iron beams.

83. The **Hoey hanger** has a cast-iron loop in the form of a stirrup; this has a recessed top fitting over a bolthead held in place by a cap that passes over the top of the hanger. The pipe is supported on a roller made of iron pipe placed over a bolt passing through each end of the stirrup.

84. The **ball-and-socket hanger** is substantially the same as the Blake, except that the base of the lagscrew, or hanging bolt, is provided with a ball on the end. This is enclosed in a socket, one-half of which is cast on the top of each leg of the loop. The socket is held in position over the ball by a bolt and nut. One of the principal advantages of the hanger is that the pipe can be lined up, by turning the lagscrew or beam clamp hanging bolt, without uncoupling the loop around the pipe.

FLOOR PLATES, CEILING PLATES, AND SLEEVES

85. Floor and ceiling plates, sometimes called **escutcheons,** are used for making a neat finish around the pipes where they pass through partitions, floors, or walls. The styles shown are made of cast iron or cast brass. Fig. 60 (*a*) shows a simple, plain cast-iron floor plate with a bead on the outer edge and at the opening through which the pipe passes. Sometimes screw holes are drilled in the plate, as shown, so that it can be secured to the floor. Fig. 60 (*b*) shows a similar plate with a collar that passes around the pipe. It is tapped for a setscrew, which, when screwed against the pipe, prevents the plate from falling down. This is generally used as a ceiling plate. Fig. 60 (*c*) shows the **Rutzler floor plate,** for use where a one-pipe riser accompanied with a small air-vent pipe passes through the floor. Fig. 60 (*d*) shows the same floor plate for two-pipe work, when the steam and return risers are accompanied with a small air-vent pipe. In these styles of plates, the

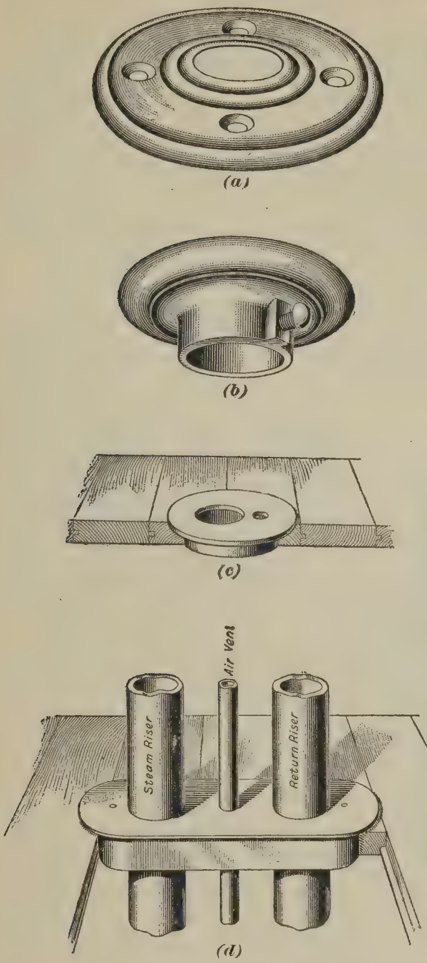


FIG. 60

small opening can be used to secure two plates, one on each side of a partition, by means of nuts and a short piece of small pipe, or an iron rod with nuts on each end.

86. If the plate shown in Fig. 60 (*b*) is used in connection with a combustible ceiling, it should have a projecting collar around the pipe at the upper opening, to prevent the pipe touching the woodwork. The plates shown in Fig. 60 (*c*) and (*d*) can also be used as ceiling plates, and may be secured in place by cleats of strap iron fastened to the bottom. The projecting flange is long enough to reach through the floor, and the straps are bent over at the floor above.

87. Screw floor plates are cast-metal plates having a recess in the bottom threaded with a regular pipe thread; they are intended to screw on a short wrought-iron nipple or tube. They can be used as floor and ceiling plates, or for walls, partitions, etc., and are the most serviceable plates and make the neatest finish for concrete or fireproof floors, etc. Screw floor plates are made of iron or brass, and can be obtained finished in various ways.

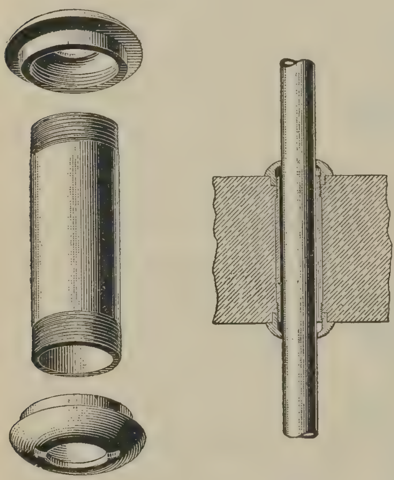

(*a*) (*b*)

FIG. 61

88. Fig. 61 shows a good screw floor plate, known as the **Hall thimble.** The three loose parts are shown in Fig. 61 (*a*), while Fig. 61 (*b*) shows the thimble in position around a steam pipe passing through a fireproof floor. The plates shown in Figs. 60 and 61 must be put in place, or at least slipped over the pipes, before the pipes are screwed up.

89. Adjustable floor and ceiling plates are also made in halves, so that they may be placed around the pipes after the work is erected. They are secured together in various ways, and when used as ceiling plates have some means of clamping them to the pipes.

90. Fig. 62 (*a*) shows the **Beaton adjustable floor plate,** while Fig. 62 (*b*) shows the corresponding ceiling plate. They are each made of two hinged halves, which when closed around the pipe are secured by a screw, as shown.

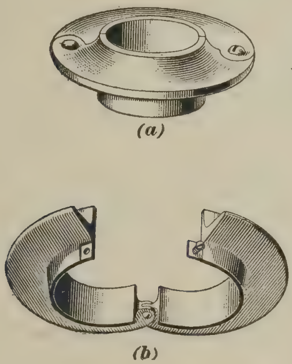


FIG. 62

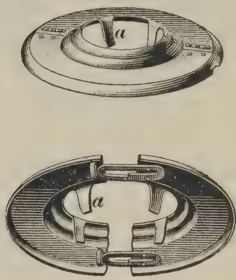


FIG. 63

91. **Stamped-metal floor plates** are stamped from sheet metal, and are lighter and lie closer to the floor, which is a good point in their favor. The **Russell plate,** shown in Fig. 63, belongs to this class. The parts are joined by a metal tongue projecting through a band on the adjoining half; a notch in the tongue secures the sections together. There is enough spring in the prongs *a* to hold the plate in place by their pressure against the pipe. One objection to this plate is that it has no flange around the pipe to protect the woodwork.

92. **Floor** and **ceiling sleeves** are made of tin or galvanized iron, and are used in connection with floor and ceiling plates to insure protection against fire and to close the opening where pipes pass through floors or partitions.

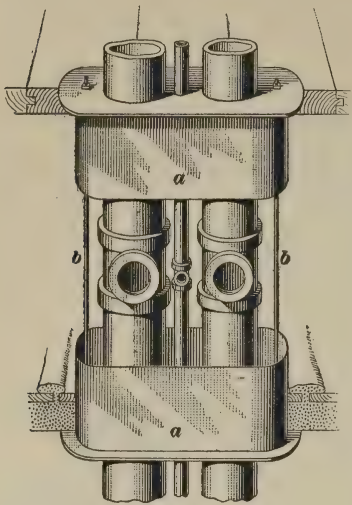


FIG. 64

93. A **double-riser sleeve** is shown in Fig. 64. It consists of two plates of the kind shown in Fig. 60 (*d*), with galvanized-iron sleeves *a*, *a* fastened to each plate. A space is left between the sleeves for taking connections from the tees shown under the floor. The sleeves can be made longer if desired, so that the pipes will be enclosed completely, one sleeve telescoping into the other. The method of securing these plates is by two small iron rods *b*, *b* with screw ends passing through both plates and having nuts.

94. Fig. 65 shows a sheet-metal **telescopic sleeve** for a single pipe. It is composed of two spun flanges, each attached to a sleeve. The lower flange is drawn up to the ceiling by cleats *a*, *a*, which are bent over and nailed to the floor, as shown. The upper flange and sleeve are pushed down in place over the lower sleeve, as shown; the upper flange is wide enough to conceal the cleats. An air space of 1 inch or more should exist between the sleeve and the steam pipe.

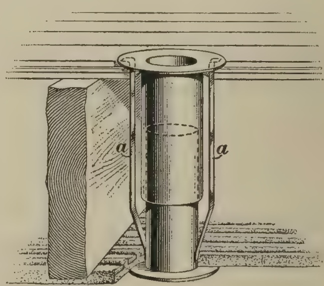


FIG. 65

95. The **Vasburg adjustable sleeve,** shown in Fig. 66, has a thread that allows the length to be adjusted and incidentally gives stiffness. This is a strong, durable sleeve, much used for good work.

96. Different localities have different laws governing the amount of space which shall be provided around the steam pipes and return pipes as a protection against possible charring of woodwork. A 1-inch air space all around the pipe is generally considered a sufficient fire-protection, and is reasonable enough to admit of connections being made without projecting the risers, etc. too far into the room.

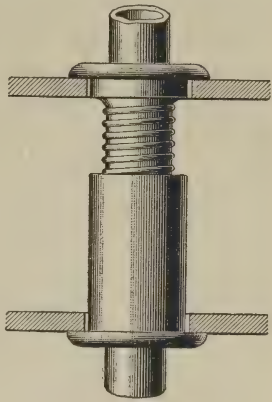


FIG. 66

97. In many buildings, it is advisable to place some fireproof filling in the space between the pipe and the sleeve, so that fire in one apartment cannot pass through to the one above or adjoining. Ordinary pipe covering will fit most of the tubes where made 1 inch larger than the pipe, or the space can be packed with loose asbestos in flakes, or with mineral wool.

98. A good fireproof finish can be obtained by using the **Nonpareil cork riser blocks,** which consist of cork pressed under a high pressure around iron-pipe sleeves. They can be built into the walls by the masons as the building is erected.

VALVES

GLOBE VALVES

99. **Valves** are used to entirely shut off or partly check the flow of steam or water in a heating system, so that the apparatus can be properly controlled. They vary in design, some being made to completely shut off the piping, while others are made to partially shut off the piping so as to reduce the steam pressure.

100. The most common type of valve is the **globe valve.** It is made with a globe-shaped body so as to give ample area for the passage of the fluid. Inside the valve is a partition with an opening at right angles to the valve stem. This opening has a seat either formed directly in the partition or secured to it by a screw joint. Over this opening is fitted a disk attached to a threaded spindle or stem; this passes through a hub or bonnet having a chamber around a part of the spindle to admit packing. A stuffingbox and gland, which adjusts the packing by forcing it into the stuffingbox, causing it to press tightly against the spindle, is fitted over the hub. The bonnet is placed in an opening in the body of the valve, the joint being made in some cases by a screw thread and in others by a packed flange and bolts. The disk is fitted carefully to the seat, so that the valve seat and disk form a tight joint when the spindle is screwed down. A wheel handle is generally used to screw the disk up and down.

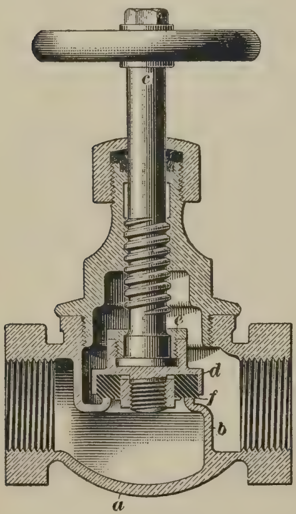


FIG. 67

101. Since the disk of a valve becomes worn by the closing and opening, and from other causes, it is often necessary to regrind it to prevent leakage. Regrinding is a tedious operation, which is done away with by using a **removable disk.** Such disks consist either of a metal casing filled with vulcanized rubber, soft metal, or hard metal, or they are fiber washers.

102. Fig. 67 shows a valve known to the trade as the **Jenkins "Diamond" valve.** This has a flat raised seat inside the body *a* of the valve and on the partition *b*. The spindle *c* is fitted with a disk *d*, which is free to rotate and is confined longitudinally by means of a locking sleeve *e*. This disk *d* has a recess into which is inserted a composition ring *f* made of rubber and vulcanized so as to stand a high temperature. It is secured in place by a nut and washer. The disk is pliable; it fits the raised seat and makes a tight joint.

103. The **Fairbanks valve** is somewhat similar in construction to the Jenkins, except that a composition ring of asbestos and vulcanite is pressed into the recess of the disk; when renewals are required, a complete new disk can be readily inserted, as the spindle is made with a shoulder *a*, Fig. 68 (*a*), fitting into a recess open on one side and on top

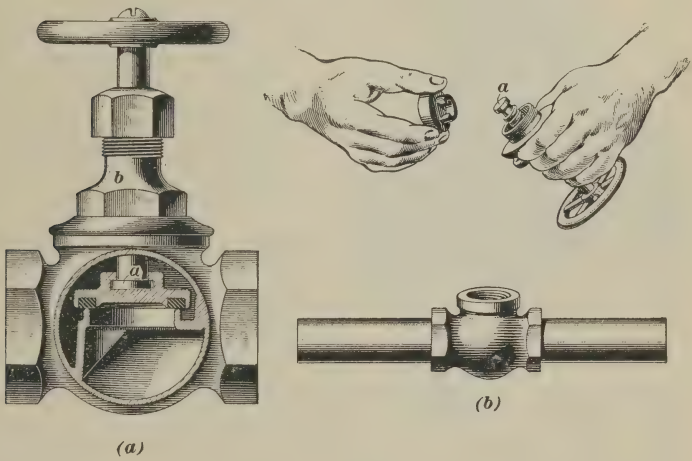


FIG. 68

of the disk, which is held in position by guides inserted in the body of the valve. This is a *quick-repairing valve*, as upon removing the hub *b* the disk can be slipped off the spindle and a new one slipped on, as shown in Fig. 68 (*b*); hence, this valve is used extensively where repairs must be made without undue loss of time.

104. The **O'Mera valve** is made similar to the Fairbanks, except that the disk has corrugations in the recess where the composition ring is placed.

105. The **Crane copper disk valve** is constructed similar to the Jenkins, with the exception that the disk is fitted with a double-faced copper ring *a*, Fig. 69, having an outer rib rounded on its face, which adjusts itself to the flat seat and forms a tight joint. The ring can be turned and used with the other edge toward the seat, should it become marred by grit or other causes. The holder is turned to form a tight joint at the top edge and sides of the copper disk. Softer metals have been used for disks of this kind, but have not proved as satisfactory as copper.

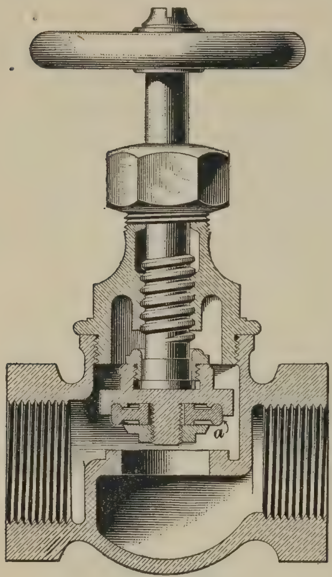


FIG. 69

106. The **Eastwood tee valve** is a type of screw-down valve having a barrel-shaped body with a partition similar to that of the globe valve. The spindle and upper section are similar in construction to that of the Jenkins valve, but the seat is made conical; the disk is of bronze and is made with a tapered and ground recess fitting over the beveled ground edge of the seat, thus forming a tight joint. The taper joint at the valve seat permits of a tighter contact between the disk and its seat than can be obtained in an ordinary flat-seated valve, assuming the same force to be applied to the spindle in each case.

107. **Iron-body valves** are made similar to **brass-body valves,** with the exception that the seat is separate; the seat is made of brass or hard metal secured to the iron body of the valve either by pressing it in or by a screw thread. The seat is usually faced true in place. The spindle box or hub is generally bolted to the body and packed with a gasket to form a tight joint. The stuffingbox is usually fitted with a gland having studs and nuts to compress the packing; a yoke is used to support the thread of the spindle.

108. Fig. 70 shows, in section, an iron-body flanged angle valve with a globe body. It is made with the outlet *a* at right angles to the inlet *b*. The seat *c* is placed directly in the inlet of the valve and offers less resistance to the fluid than the seat of the ordinary globe valve. It is therefore a good valve to use when the conditions will permit this; besides, it saves an elbow and sometimes a nipple, because it takes the place of an elbow. Owing to the long spindle, the disk is provided with a guide *d* that moves in a hole drilled through a spider *e* cast in one piece with the brass seat. The hole in *e* is concentric with the valve seat, and the valve disk *f* is consequently guided straight to its seat. The valve shown in Fig. 70 is intended for high-pressure work, such as 250 pounds pressure or less, and is tested to 800 pounds pressure by the manufacturer.

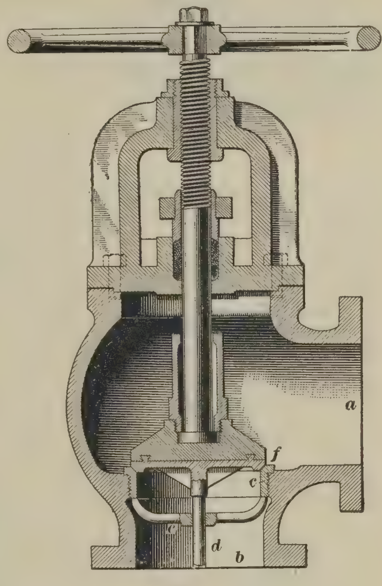


FIG. 70

109. The **Y valve,** shown in Fig. 71, is a form of valve that is similar in many respects to the globe valve, but offers less resistance to the flow of the liquid, as the seat *a* is set at an angle of about 45° with the run of the valve. It is really midway between a globe valve and a straightway or gate valve. It is often used as a blowoff valve. This style of valve, the same as globe and angle valves, can be had with the Fairbanks, Jenkins, or other construction of disk.

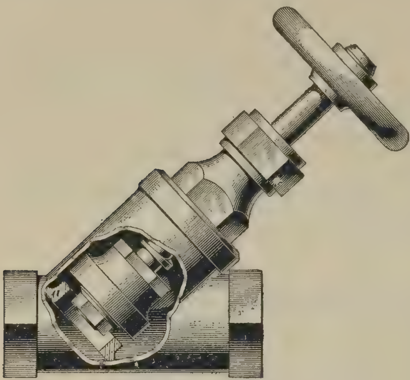


FIG. 71

110. The **packing-less valve** shown in Fig. 72 is a type of valve that has lately been placed on the market. It is made in the globe and angle patterns, either with a renewable double disk or with the Jenkins type of disk with renewable ring. A peculiar feature of this valve is that the packing around the valve stem is dispensed with, and that the valve disk does not turn. The valve stem *a* is confined longitudinally by a collar *b* and a nut *c*. A seat is formed within the hub *d*, and a hard rubber washer *e* is fastened to the lower end of the collar *b* by a locknut. A brass collar *f* is ground to the upper end of the collar to form a tight joint, and is prevented from turning by two lugs entering corresponding grooves in the hub.

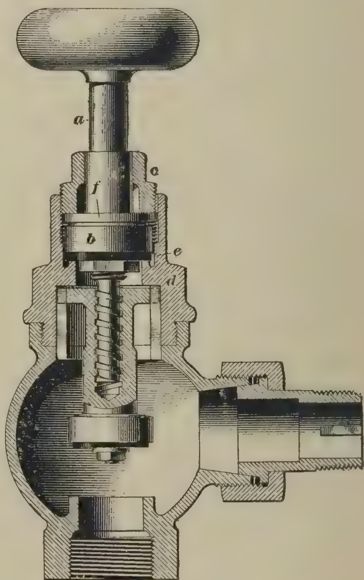


FIG. 72

It is thus seen that while the

valve stem is left free to turn, it is confined longitudinally, and a steam-tight joint is made. The lower end of the valve stem is threaded to fit the socket, which has the valve disk at its lower end, the socket being movable longitudinally, but prevented from turning by two opposite guides entering corresponding slots in the upper collar of the socket.

Packingless valves are very good for air-pressure or vacuum work, and are superior to the ordinary packed valves, since in the latter the joint between the valve stem and the hub is hard to make and keep air-tight.

111. All the valves shown in Figs. 67 to 72 are known as **compression,** or **screw-down, valves.**

GATE VALVES

112. **Gate valves** are straightway valves made either as **single-gate valves,** which only bear pressure on one side, and **double-gate valves,** which bear pressure on both sides. Many forms of double-gate valves are made, some of which close the opening in the run of the valve with a solid wedge; others close with a box wedge, and others with sectional gates having either parallel or wedge-shaped seats.

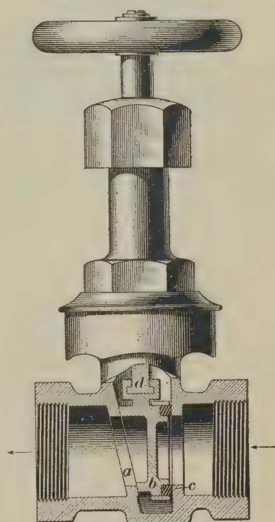


FIG. 73

113. The **Jenkins gate valve,** shown in Fig. 73, has a wedge-shaped body. An inclined guide *a* at one end forces the gate, or disk, *b* to its seat *c* when the spindle is screwed down tight. The disk is loose on the spindle *d*, being made with a recess; a removable ring is secured to the disk, the same as is done in globe and angle valves. This is a single-gate valve, bearing pressure only on one side.

114. The **Ludlow gate valve** is made with a solid metal disk, and is a loose disk valve, the disk being forced against the seat by a double wedge at the back of the disk. As the disk is hung from the wedge, it is lifted away from the seat on opening and hence does not slide upon the seat. When it is closed, it fits against a seat on the valve, which is at right angles to the flow of the liquid.

115. The **Chapman valve,** shown in Fig. 74, is a double-gate valve with a solid or cored disk *a* made tapering, which is machined flat on the sides and is guided by a slot *b* in each side of the disk fitting over a guide *c* at each side of the valve body; the disk seats against soft metallic rings *d*, *d*, firmly embedded at each side of the opening in the run and faced off to the same taper as the disk. The valve shown is an iron-body flanged gate valve. The lower end of the stem is threaded, and the disk travels on this thread, the stem being prevented from rising by the collar *e*.

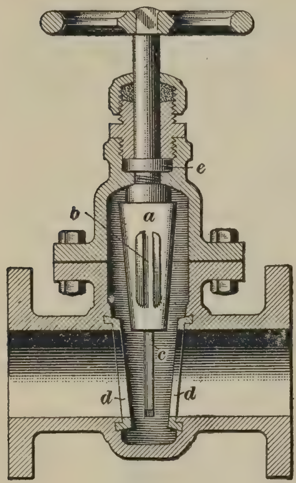


Fig. 74

116. The **Walworth gate valve** is similar in construction to the Ludlow valve, except that the seat in the body of the valve is a screwed ring faced to match the face of the disk. The **Fairbanks,** the **Kennedy,** and many other gate valves are similar in shape and general mode of operation to those described, differing only in minor details.

117. Gate valves are used where but little resistance to the flow of the liquid is desired, and therefore are largely used on water and exhaust-steam connections. When they are used for steam, however, the seats should be made of bronze to successfully stand the high temperatures. In all gate valves, the disks rise into the upper part of the body and bonnet to allow a straight passage for the liquid. The large sizes of gate valves are usually made with a yoke and outside screw, the spindle rising in a threaded hub at the top of the yoke. The rise of the spindle in this form of valve indicates whether the valve is open or closed.

SPECIAL VALVES

118. The **elbow valve** shown in Fig. 75 is a new type of valve used chiefly for blow-off connections from boilers, but can be used for other purposes. It consists of a screw-down valve with an internally curved plug *a* having a soft-metal ring *b* around it. The spindle construction is similar to that of the ordinary valve. The plug is guided in its travel by guides, not shown; they prevent its turning and keep the curved recess of the plug in line with the outlet.

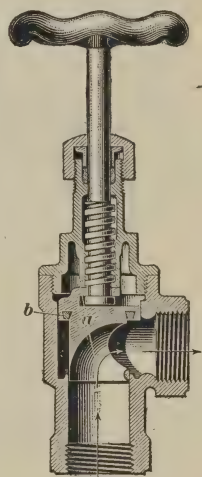


Fig. 75

119. **Tee, or cross, valves** are similar to globe valves and angle valves in construction. The valve closes off one port in the tee, the seat being placed in the inlet, like in the angle valve. They are used in some cases for mains, where a connection is brought into a main line, or for the steam-pipe connections on boilers.

RADIATOR VALVES

120. **Radiator valves** are constructed similar to globe, angle, and gate valves. To suit special conditions, they are made in different types, such as *offset globe valves*, *offset angle* *valves*, *corner valves*, and *corner offset valves*. The principal distinguishing feature of radiator valves is that they are usually nickel plated, and that wooden handles are used instead of metal handles. The nickel-plated finish is applied for the sake of appearance, because radiator valves are always located in the rooms to be warmed. The wooden wheel handles are used to prevent the hands being burned in operating the valves. Radiator valves can also be had finished in plain rough brass, or with nickel-plated trimmings, or with finished and polished bodies.

121. The **angle valve** is most commonly used for a radiator, because the steam pipe *a*, Fig. 76, usually comes up through the floor and connects to the end of the radiator, as shown. The connection is usually made with a ground coupling having a hexagon nut *b*. The coupling tail *c* is screwed into the radiator tapping, and the hexagon nut screws on to the valve.

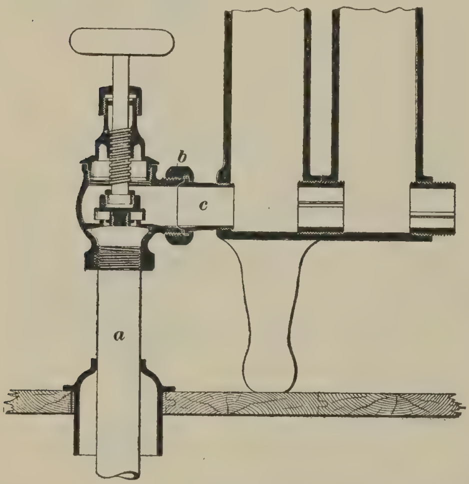


FIG. 76

122. The **corner valve** is made similar to the globe valve, except that the partition in the body is placed so as to allow the outlet of the valve to be made at the side of the globe body. Corner valves are used in places where direct connections with ordinary valves cannot be made. The offset globe valve is similar to the angle valve in general constructions, except that the outlet is in a line parallel with the inlet, but at a lower level. It is preferable to the straightway globe valve in making radiator connections, because it admits of draining the radiator when open, which the ordinary globe valve will not do unless it is placed with the spindle horizontal.

123. An **offset corner valve** is shown in Fig. 77. It is the same in construction as the offset globe valve, except that the inlet *a* and outlet *b* are at right angles. It is really an offset angle valve with the outlet at an angle of 90° to the axis of the inlet seat at the lower level. The construction of the working parts is the same as that of any globe valve. Offset corner valves are made right hand or left hand to suit the connection in the radiator, and are listed by most makers. The corner valve with the inlet and outlet in the same plane is not made by many manufacturers.

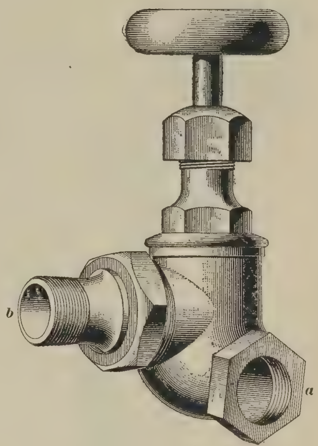


FIG. 77

124. All the valves mentioned in the previous articles can be obtained with special key handles, and also with a shielded stem that protects the square that the key fits, so that they cannot be moved without the key. These valves are useful in schools, asylums, etc., as unauthorized persons cannot meddle with them. They are also made with a ground union joint for connecting to the radiator, as shown in Fig. 77, which makes it easy to connect and disconnect the radiator without disturbing the pipe connections.

125. The **Universal radiator valve** is a valve that has lately been placed on the market; it is the ordinary type of radiator valve of the angle pattern fitted with a ground joint union *a*, Fig. 78, on the bottom and connected to a sleeve *b*, which allows adjustment to any angle in a horizontal plane. The sleeve is made with a female thread at the opposite end to which the piping is connected. A disadvantage of this valve is that the joint is on the pressure side, and, therefore, if the joint leaks the entire line of piping will have to be shut off before it can be reground.

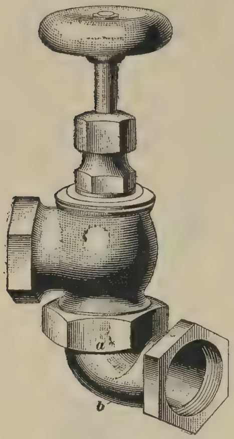


FIG. 78

126. The **Collis circulating valve** is a valve by means of which a very neat and sightly job can be made of the radiator connections in a two-pipe system, as the steam and return pipes will be close together. The general construction is similar to that of the offset globe valve; the valve, as shown in Fig. 79, has an inlet *a* for the steam and an outlet *b* for the water of condensation; the nipple *c* is connected to the radiator. The condensation is carried off by a separate pipe. By using this valve, the necessity of having two valves to a radiator is done away with in two-pipe steam-heating systems, and the circulation in the heating system is not interfered with by closing the valve, which simply shuts off the steam from the radiator. At the same time the filling of the radiator with water from the return pipe is obviated, which is likely to occur when a radiator with

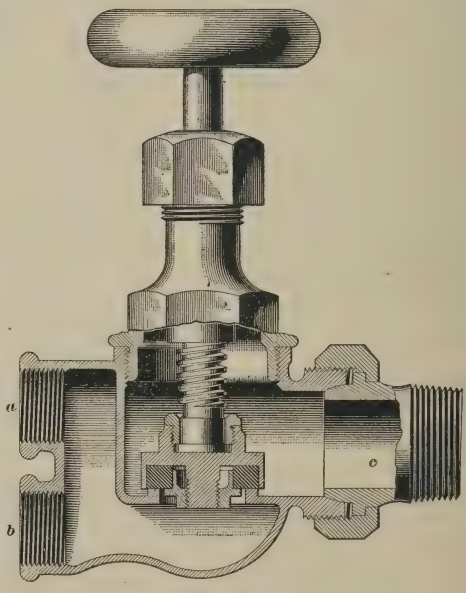


FIG. 79

separate steam and return valves is shut off by closing the steam valve only.

127. Radiator gate valves are similar to the gate valves before described, except that they have wooden wheels. The gate valve for connections to radiators admits the steam in a straight line without the resistance offered by the other types of valves, allowing the water of condensation to drain freely when used with one-pipe connection to the radiators, for which work it answers best when the connections are carried over the floor. They are finished in plain brass, or with nickeled trimmings, or nickeled all over, and in some cases are fitted with ground joint union connections.

CHECK-VALVES

128. **Check-valves** are valves that permit a fluid to pass through them in only one direction; they are designed so as to close automatically whenever the flow of the fluid is reversed. Check-valves are made in different forms, such as *vertical*, *horizontal*, *angle*, and *straightway*, or *swinging*, *check-valves*. The first is made with a globe-shaped body to allow a free passage for the fluid through the opening in the seat. The partition has either a tapering or a flat seat; the disk is fitted with a stem that is supported by a guide, so as to keep it in line with the seat and prevent side motion. In the large sizes having an iron body, an opening giving access to the disk is placed in the side of the body and closed with a blind flange, shown at *a* in Fig. 80. The smaller sizes are made of brass and can be taken apart like a union. The horizontal

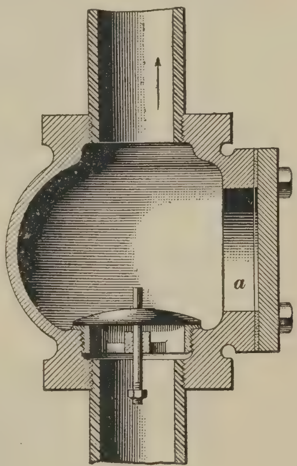


FIG. 80

check-valve has a body similar to that of a globe valve; the top opening is closed by a hollow cap forming a guide for the short stem of the valve disk, the disk being ground to the seat; sometimes the disk is fitted with a removable washer.

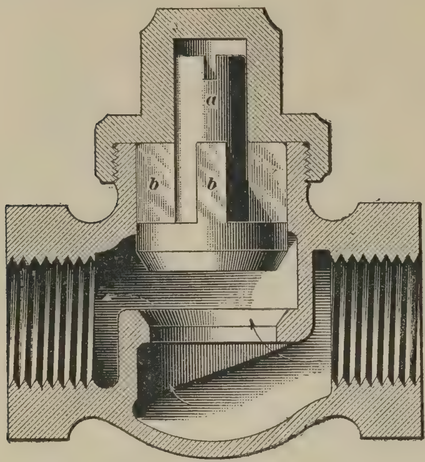


FIG. 81

Fig. 81 shows the **Powell check-valve,** whose special feature is the extension *a* to the guides *b*, *b*. Water flows through the check-valve in the direction shown, but cannot return. The angle check is similar in construction to Fig. 81, except that the body of the valve is the same as that of the ordinary angle valve, and, like the angle valve, it saves an elbow.

129. The **swing check-valve** is made different from the globe check-valve; it has a more direct water passage, and is easier to open. Fig. 82 shows the **Barnham swing check-valve.** The disk *a* is carried by a lever *b* that swings on a pivot *c*. The disk fits the lever arm loosely and is thus allowed to rotate and seat itself on the angular partition of the valve. An advantage of this form of swing check is that an ordinary mechanic can reseat the valve by unscrewing

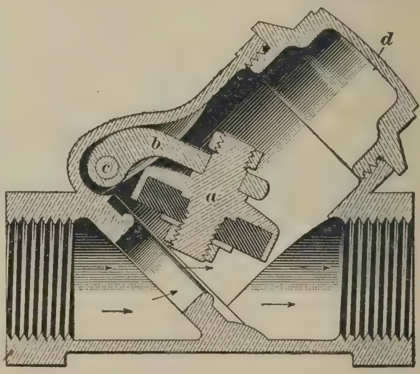


FIG. 82

the cap *d* and inserting a valve-facing tool. It also has a removable disk, as shown.

130. The **lock check-valve** is a straightway valve that is a combination check-valve and stop-valve. It has a swing check-valve that can be partially or entirely closed by a threaded spindle carrying a hand wheel. From this it follows that the amount of fluid passing through the valve can be regulated by means of the adjusting spindle.

131. Check-valves are very useful in steam-heating work, as they prevent a return of steam or water, which often happens when unequal pressures prevail in different pipes. They form a proper seal without offering much resistance. The best check-valves for return pipes are those that are as nearly self-draining as possible. The horizontal swing valves having a straightway passage should therefore be used. The lift check with the globe body is not suitable for such work, because the partition in the body forms a pocket or trap. Vertical check-valves are occasionally used in making vertical connections to boilers, but are not recommended, as it is very difficult to remove them when so placed. The horizontal swing checks can be used vertically, although this practice is not recommended.

PIPES AND FITTINGS

EXAMINATION QUESTIONS

(1) About what is the safe working pressure of standard wrought-iron pipe ?

(2) For what class of work is extra-strong wrought-iron pipe used ?

(3) Which class of boiler tubes do you consider best for use in stationary boilers ? Give reason.

(4) At what pressure is spiral riveted pipe tested ?

(5) (*a*) Where is it advisable to use cast-iron pipe for steam work ? (*b*) Also describe the usual method of connecting the pipe.

(6) Briefly describe the use of brass pipe in steam work.

(7) Describe the distinguishing characteristic of a right-and-left elbow.

(8) Describe the purpose of a division tee.

(9) Describe the purpose of a manifold tee.

(10) For what is an eccentric cross used ?

(11) Explain the use of a floor and ceiling sleeve.

(12) Describe the distinguishing features of a gate valve.

(13) State some of the advantages of the radiator valve shown in Fig. 79.

(14) What class of check-valves is best adapted for use on return pipes ? Give reasons.

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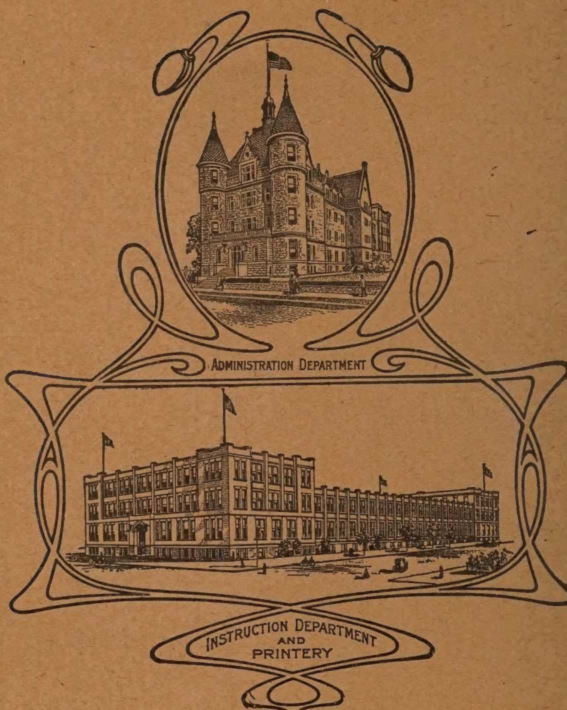
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